

Postharvest Christmas Tree Research in NC

Jeff Owen

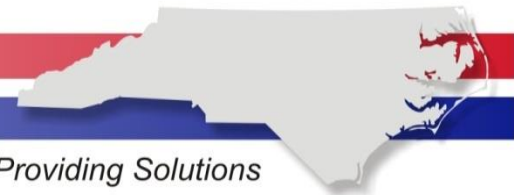
Area Extension Forestry Specialist

NC State University
A&T State University
**COOPERATIVE
EXTENSION**

Empowering People • Providing Solutions

Postharvest Research Areas

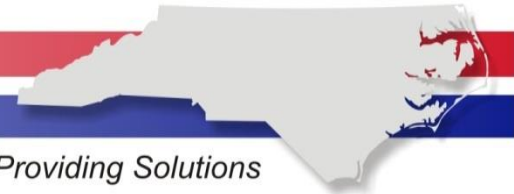
- 2015 / 2016 studies
 - Harvest timing,
 - Heat of respiration,
 - Forced air cooling,
 - & Retail pallet studies
 - Amendments (1-MCP)
- Not reporting on:
 - Trunk crack treatments
 - Fire retardants



Harvest Timing Studies



- Annual timing studies conducted last 5 years
- Branches are harvested from the same 30 trees for each date
 - early and late October
 - early and middle November
- One branch stored dry & one in a water jar



Needle Loss Rating - Simplified

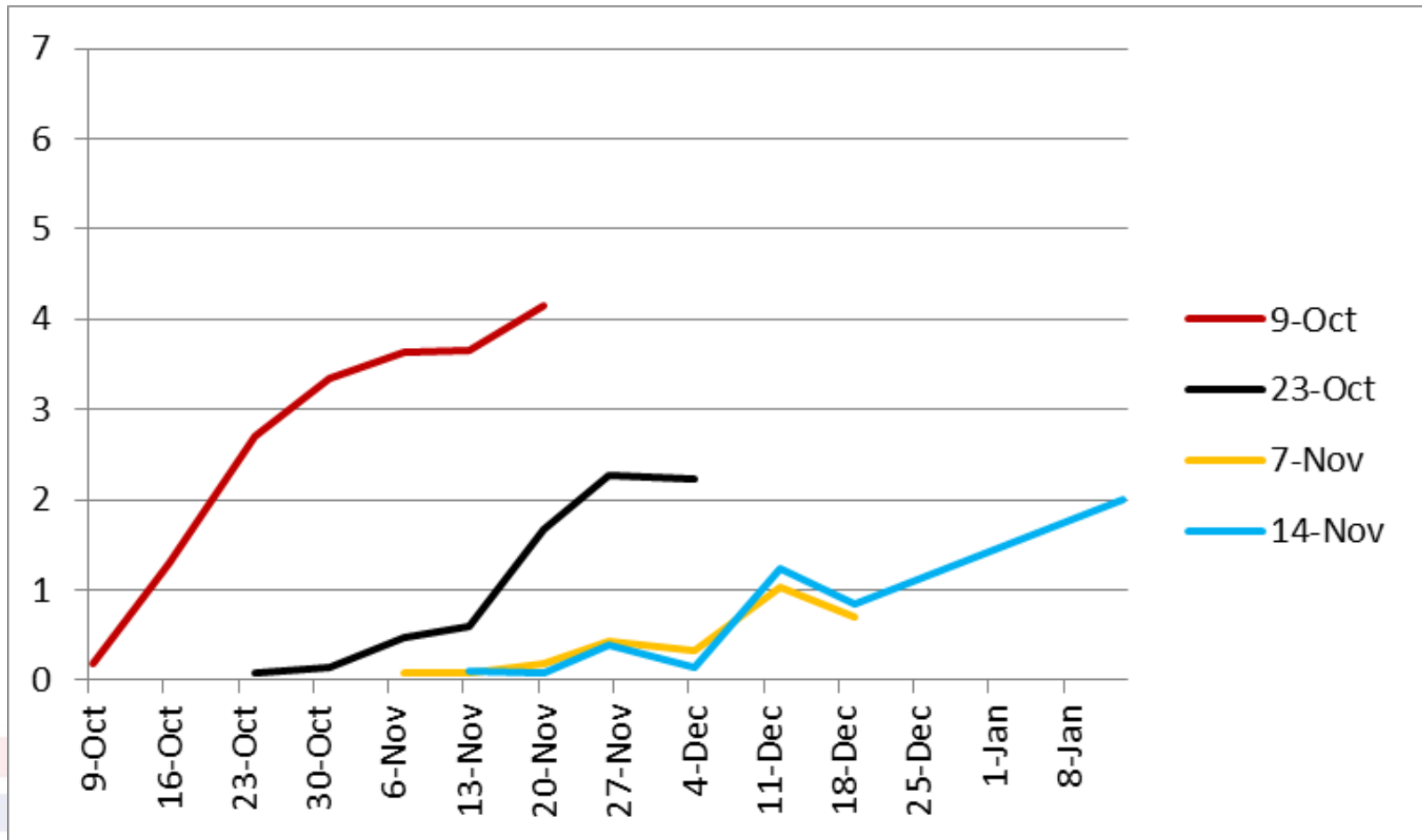
- 0-1 = no gaps, scant mess

Perfect !

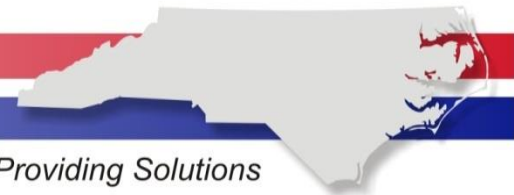
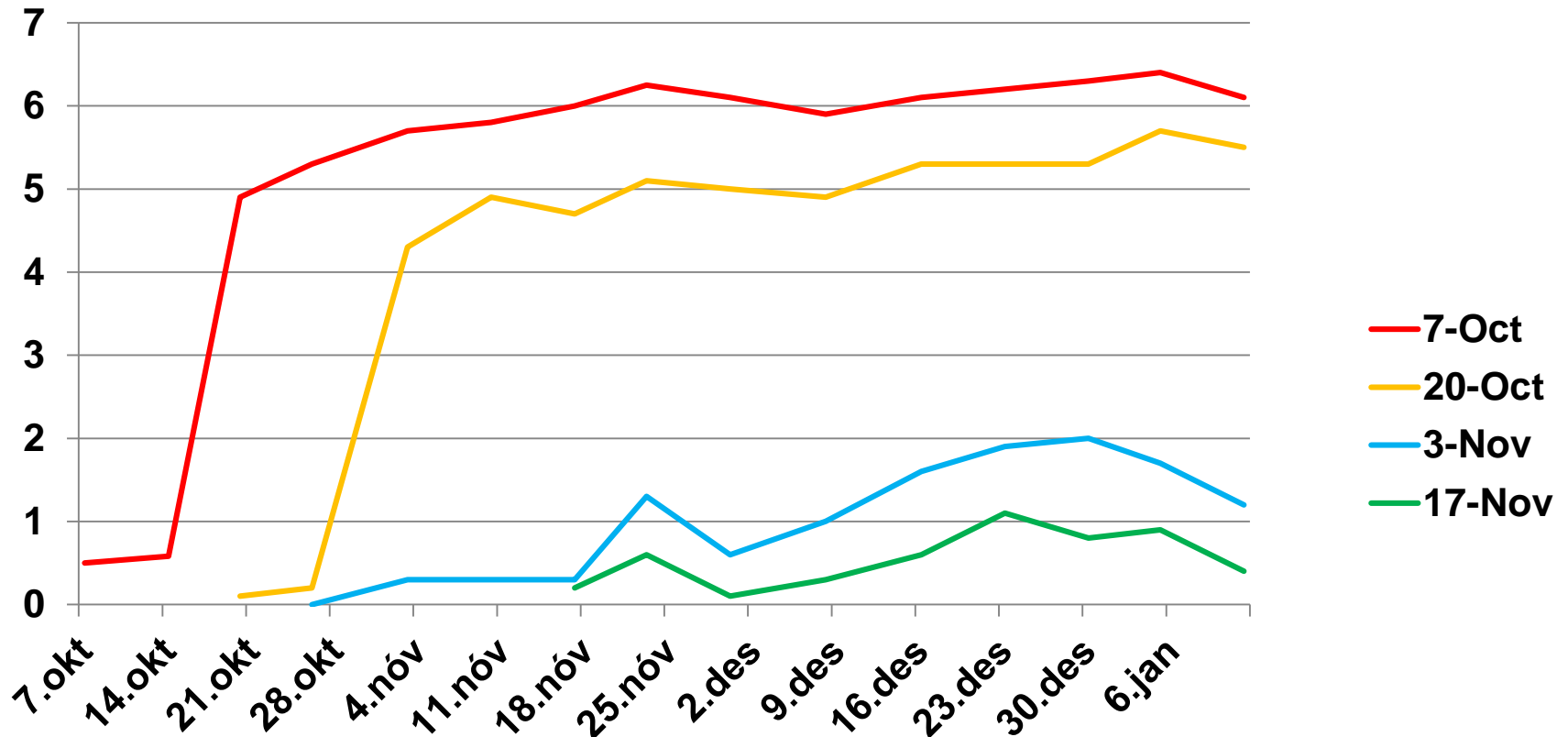
- 2-3 = no gaps, a little mess
- 4-5 = visible gaps, lots of mess, marginal quality
- 6-7 = unacceptable needle loss from branches



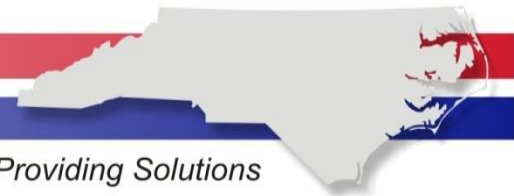
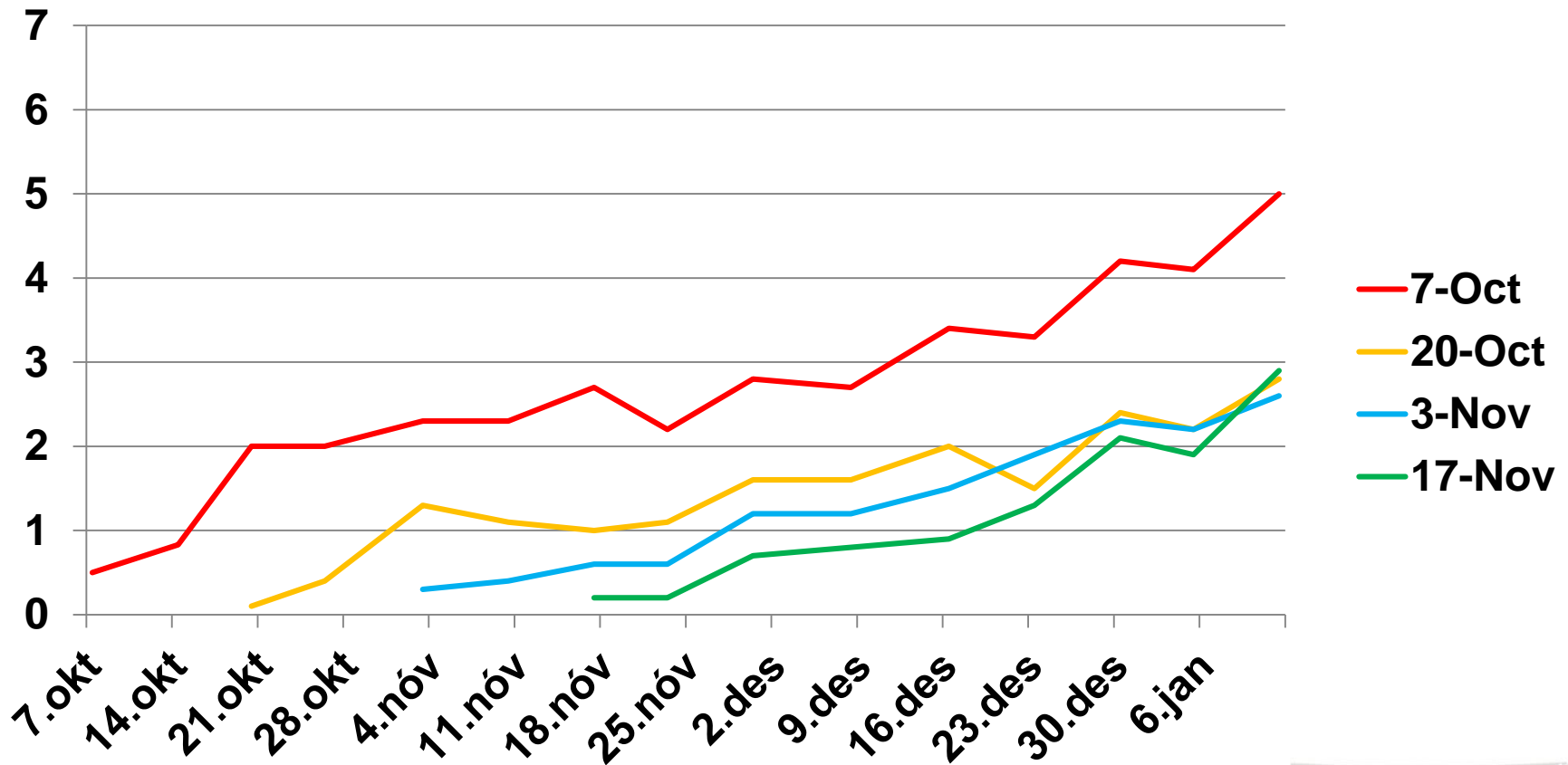
Typical Needle Retention across 4 Harvest Dates (2013)



2016 Harvest Timing Study Needle Retention Rating (DRY)



2016 Harvest Timing Study Needle Retention Rating (WET)

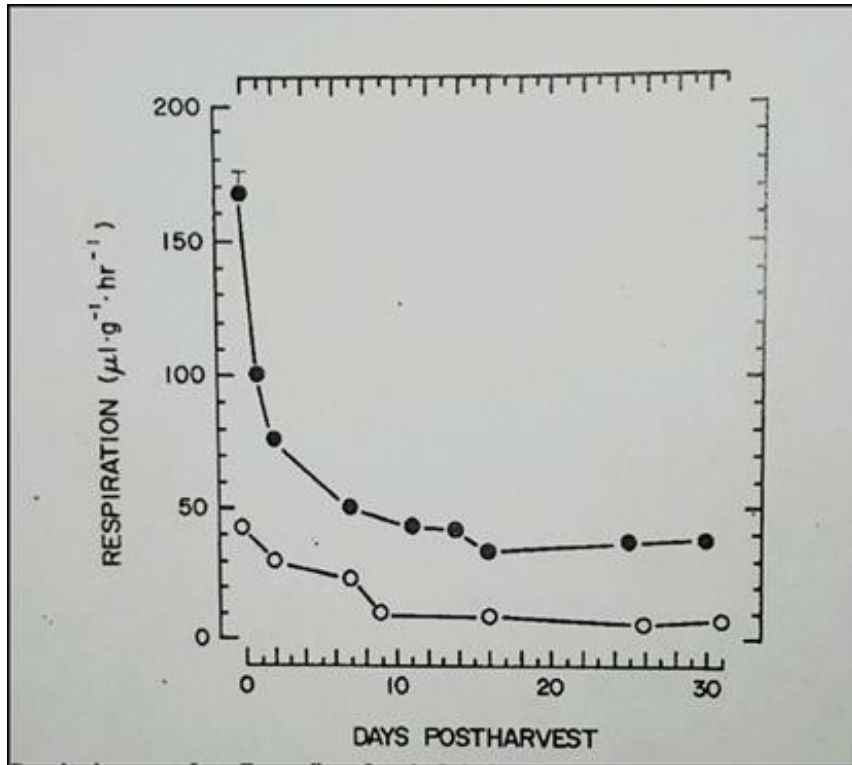


Harvest Timing Studies

- Clearly better performance when branches were not under moisture-stress
- Better performance after dormancy occurs
 - Several cold nights below 4 C (40 F)
 - Shorter days, longer nights
 - Photosynthesis is required
- *Cannot induce dormancy in a warehouse or a White pine stand*
- If you cut early, humidify !

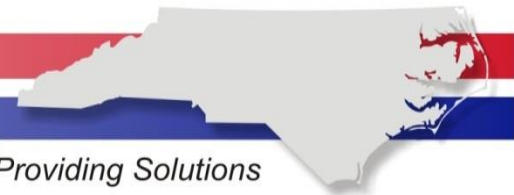


Heat of Respiration



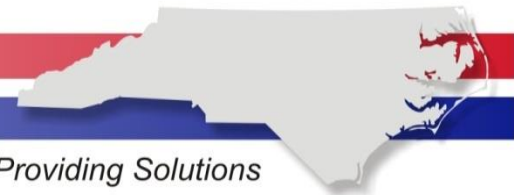
(Blankenship & Hinesley, 1990)

- 4X the heat released at 21 C vs. 4 C
- 2X the heat on 1st day after harvest compared to 2nd day
- Planned a study in 2014, but a cold snap interfered with our plans



2015 Heat of Respiration Study

- Harvested on October 21
 - We recorded a high of 23 C
- Built 6 Pallets (33 - 2 meter trees each) provided by Kathy Shore Nursery
- Palletized at 5 different intervals after harvest
- Evaluated on November 3



Treatments:

Pallets were constructed on:

Day 0 – Cooler

Day 0 – Outside

Day 1 – Outside

Day 2 – Outside

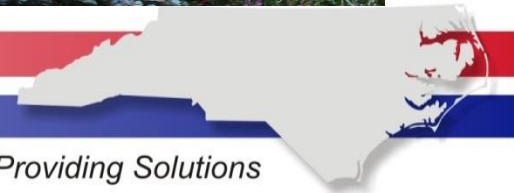
Day 4 – Outside

Day 7 – Outside



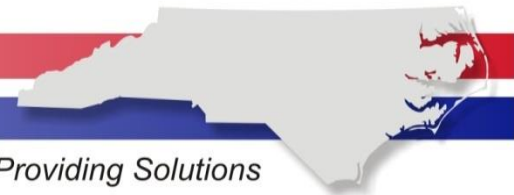
November 3 Evaluation (14 days)

- Pockets of foliage warm to the touch
- Hot spots with bronze scalded patches or bands
- Bright green foliage – melted waxy cuticle
- Additional thumb-sized brown spots

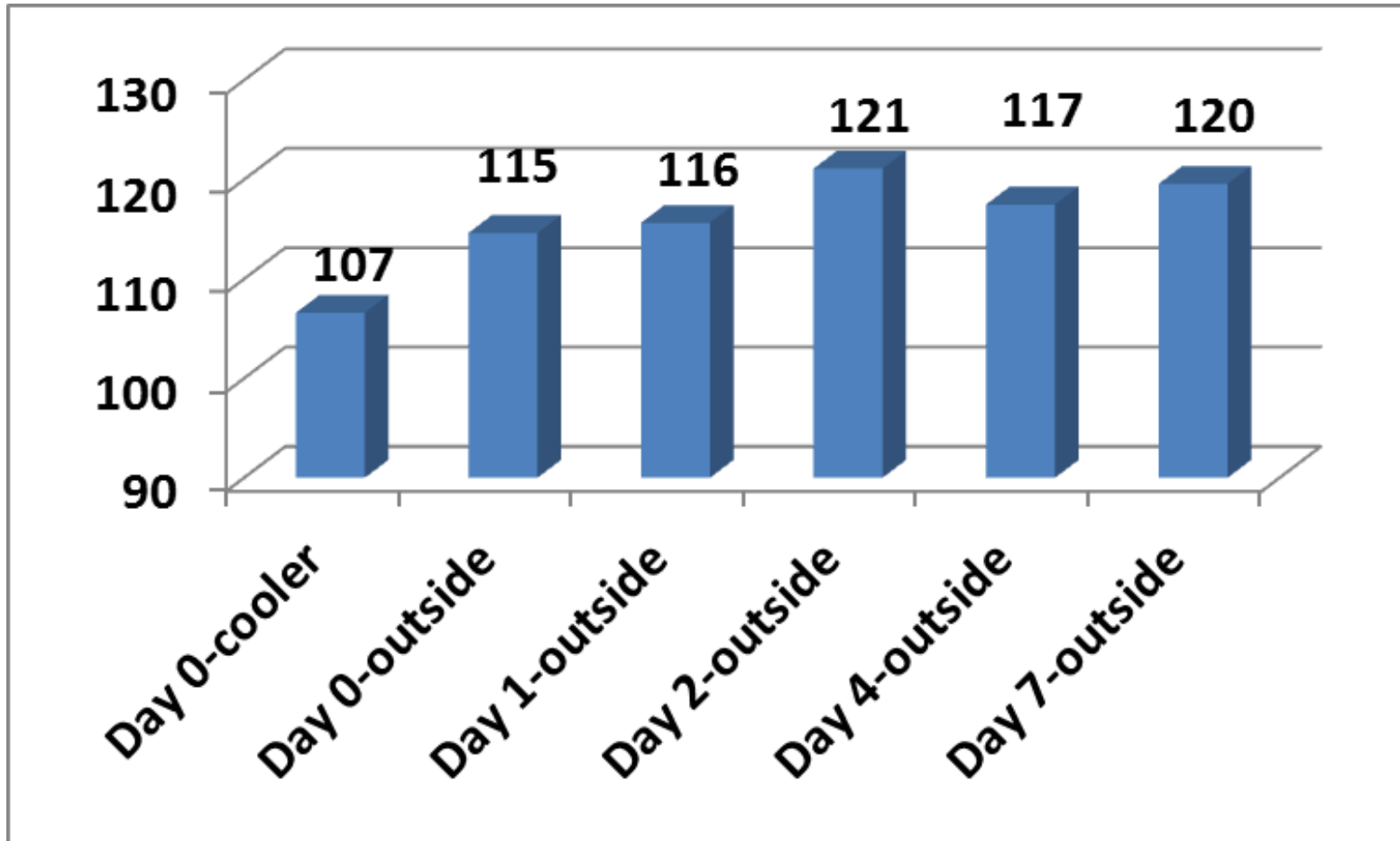


Frequency of Scalded Trees

Treatment	No Dmg	Very Light	Light	Moderate	Severe
Day 0-cooler	18	13	1		
Day 0-outside	17	7	4	2	
Day 1-outside	6	6	7	5	9
Day 2-outside	3	5	2	4	16
Day 4-outside	14	7	10	2	
Day 7-outside	20	8	5		



Nov. 3 Moisture Content (MC%)

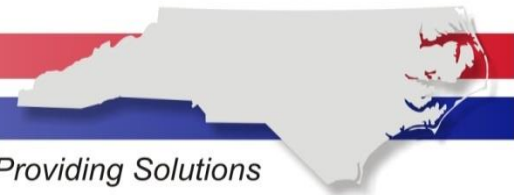


Data Logger Results

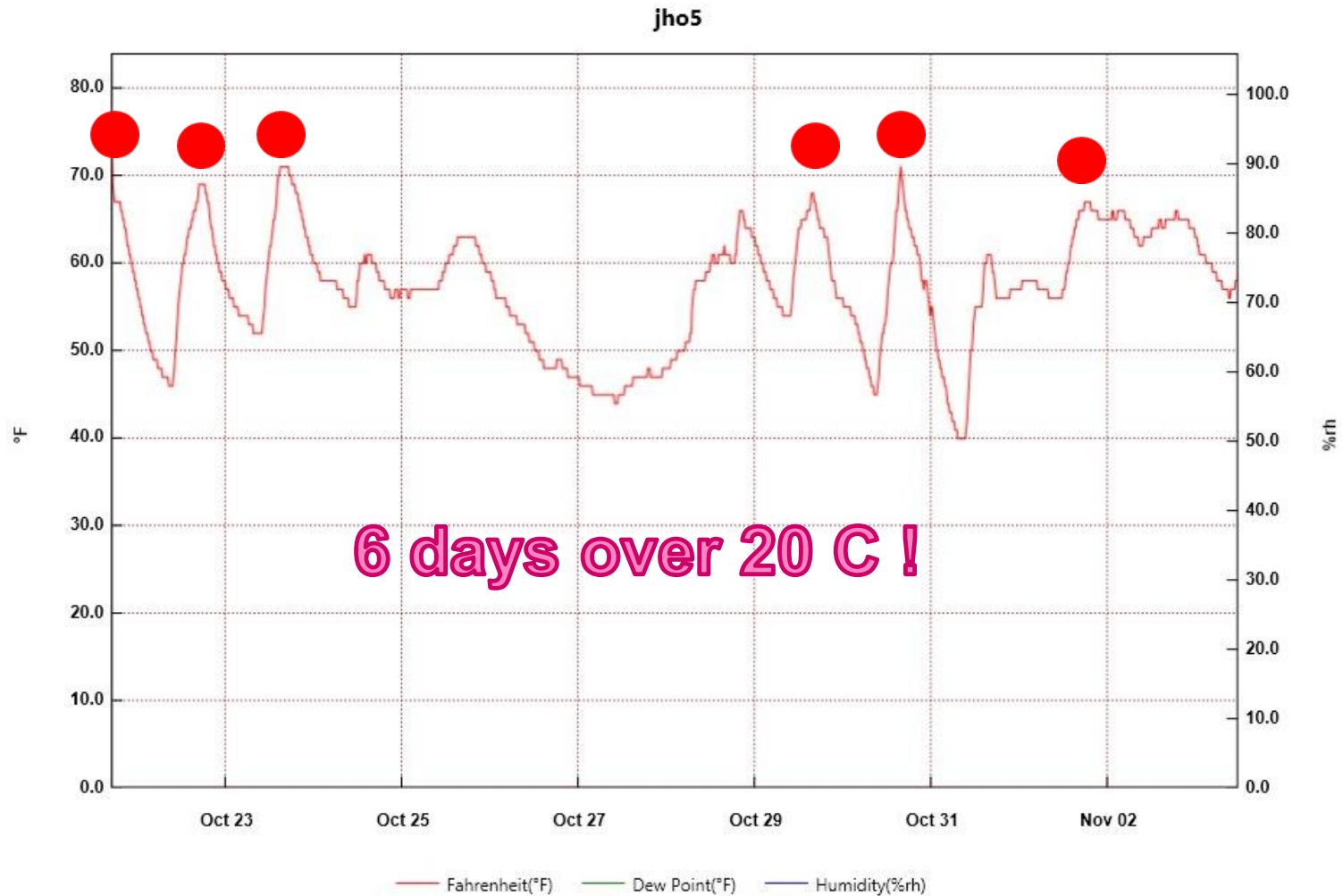
Temperature, Relative Humidity, & Dew Point



Two Loggers per Pallet



Ambient Temperatures in Sparta October 21 to November 3



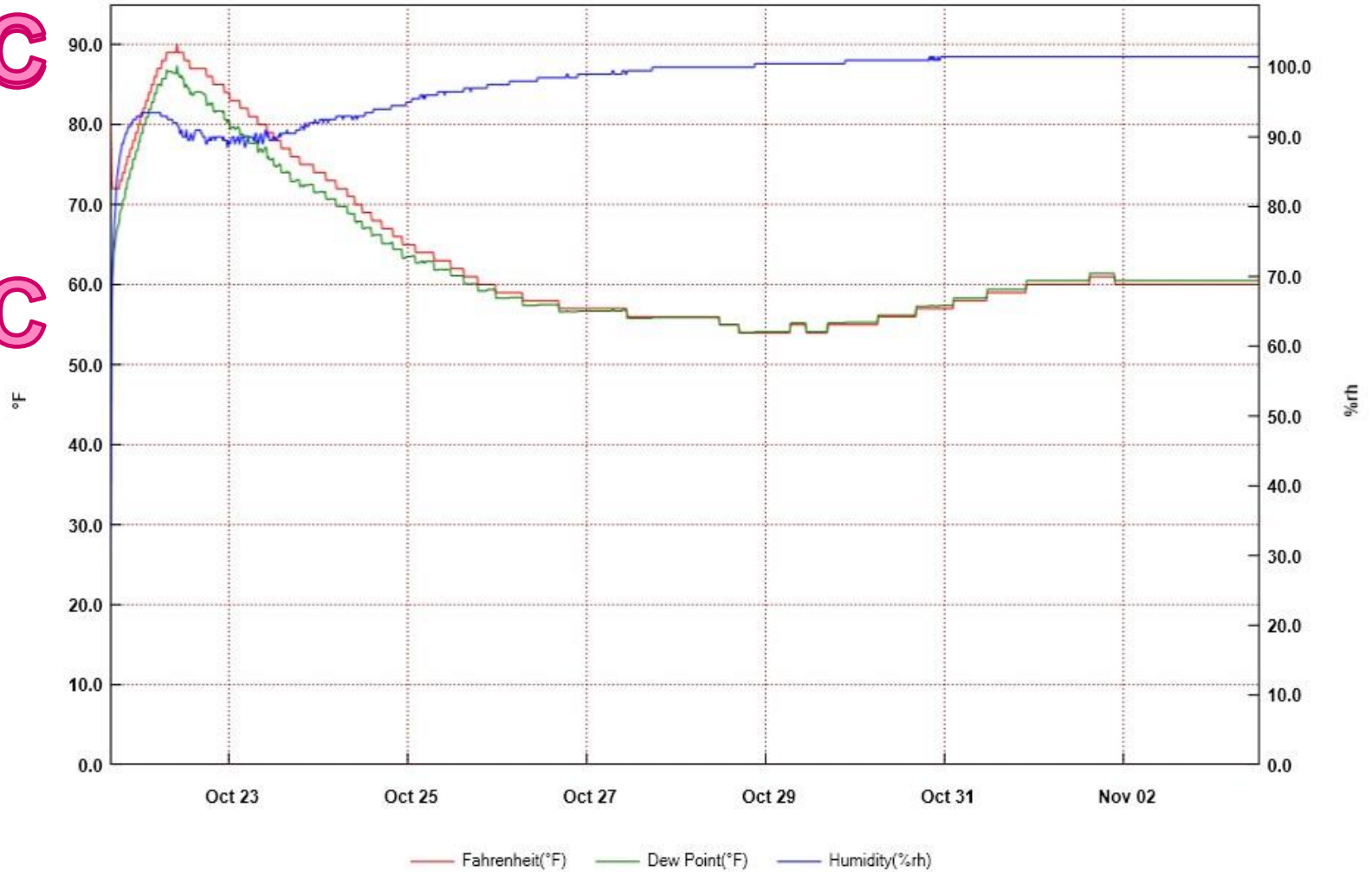
From: Wednesday, October 21, 2015 4:54:14 PM - To: Tuesday, November 03, 2015 11:39:14 AM

Day "0," Stored in Cooler

jho2

32 C

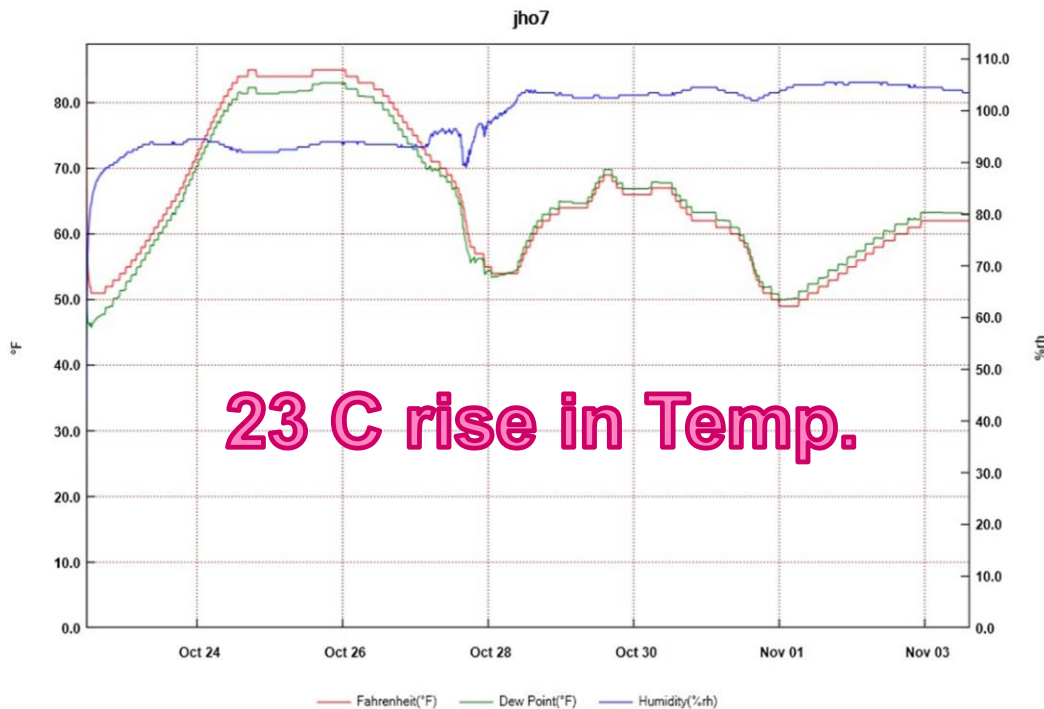
13 C



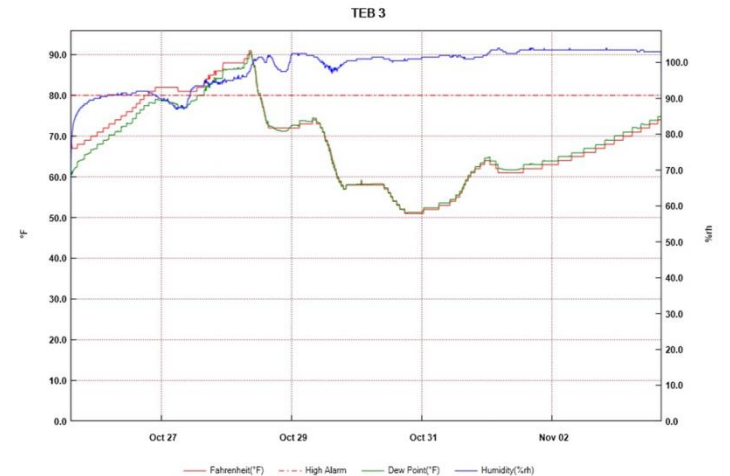
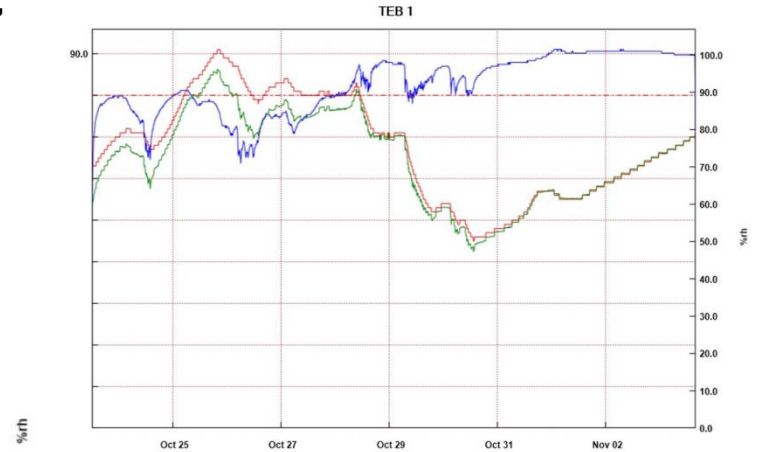
From: Wednesday, October 21, 2015 4:04:56 PM - To: Tuesday, November 03, 2015 12:34:56 PM

2015 Heat of Respiration Study

- Similar “HoR bumps” in Temp for days 0,1, 2, & 4 but not day 7



From: Thursday, October 22, 2015 11:21:53 AM - To: Tuesday, November 03, 2015 2:51:53 PM

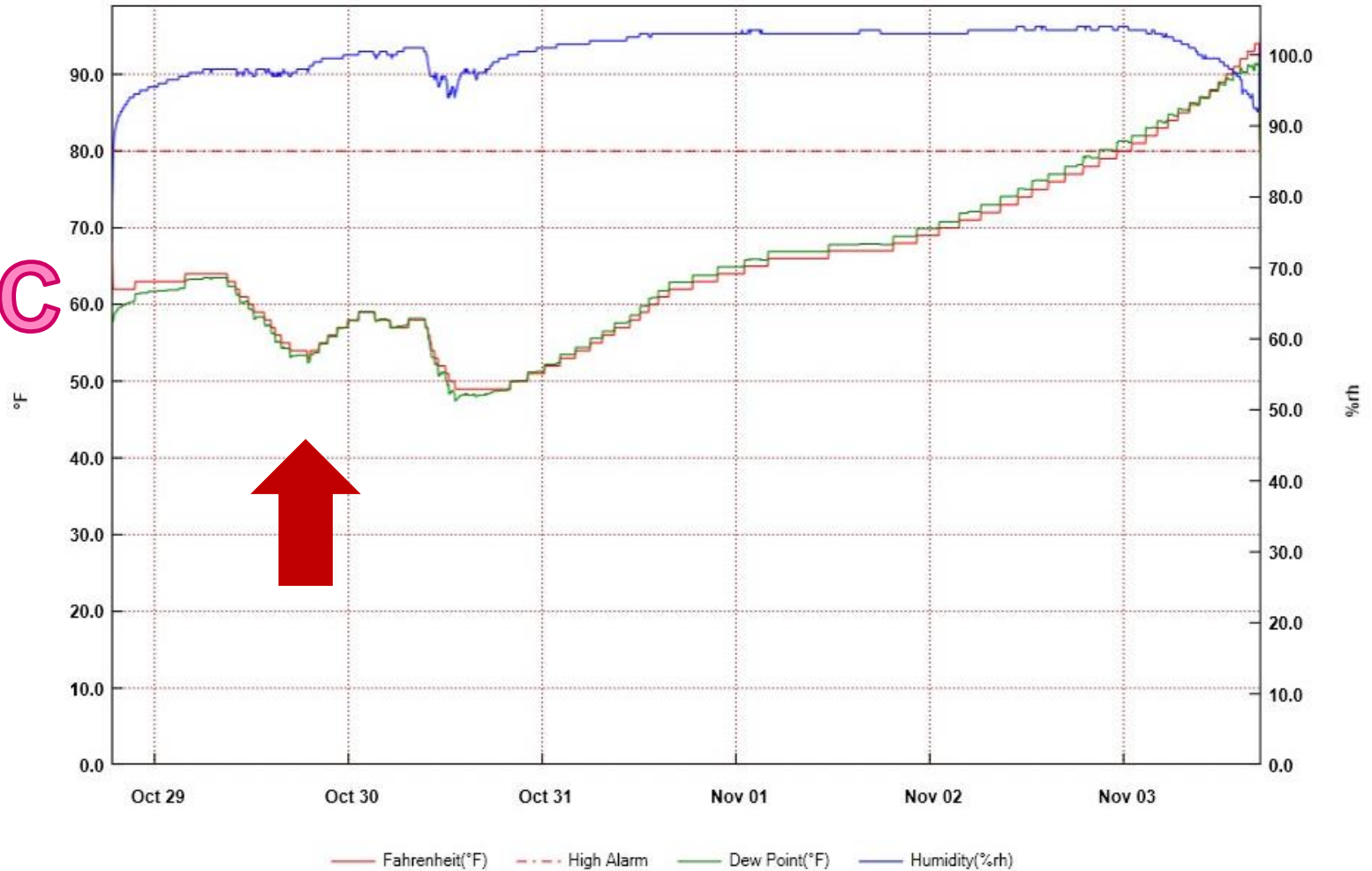


From: Sunday, October 25, 2015 2:24:58 PM - To: Tuesday, November 03, 2015 4:24:58 PM

Day "7," Outside

TEB 4

16 C



From: Wednesday, October 28, 2015 6:37:17 PM - To: Tuesday, November 03, 2015 5:02:17 PM

Heat of Respiration

- Pattern of heating above ambient temperature when trees are palletized in first 1- 4 days after harvest
- Followed by a drop back to ambient temperature
- Hottest areas in pallets were associated with the scald symptoms



32 C

TEB 4



Now, Let's look here

From: Wednesday, October 28, 2015 6:37:17 PM - To: Tuesday, November 03, 2015 5:02:17 PM



A Different Mechanism ?

- Possible heat of microbial respiration
 - Temperatures were still ascending when opened
- Heavy rain at the time of palletization
- Delayed rising temperatures observed in other pallets in this study to a lesser degree
- Not just an anomaly



2016 Heat of Respiration Study

- 7 Pallets of trees (198) provided by G&S Trees
 - 35 6-8 ft. trees per pallet
- Palletized at 5 different intervals after harvest
 - 5 “dry” pallets
 - **2 watered pallets**
- Harvested on October 17
 - Reached a high of 21 C
 - Started earlier than growers
- Evaluated on November 4



Treatments

Day 0 – Loose Check

Day 0 – Dry

Day 1 – Dry

Day 2 – Dry

Day 4 – Dry

Day 7 – Dry

Day 0 – Wet

Day 7 – Wet



Ambient Temperature



6 days over 20 C !

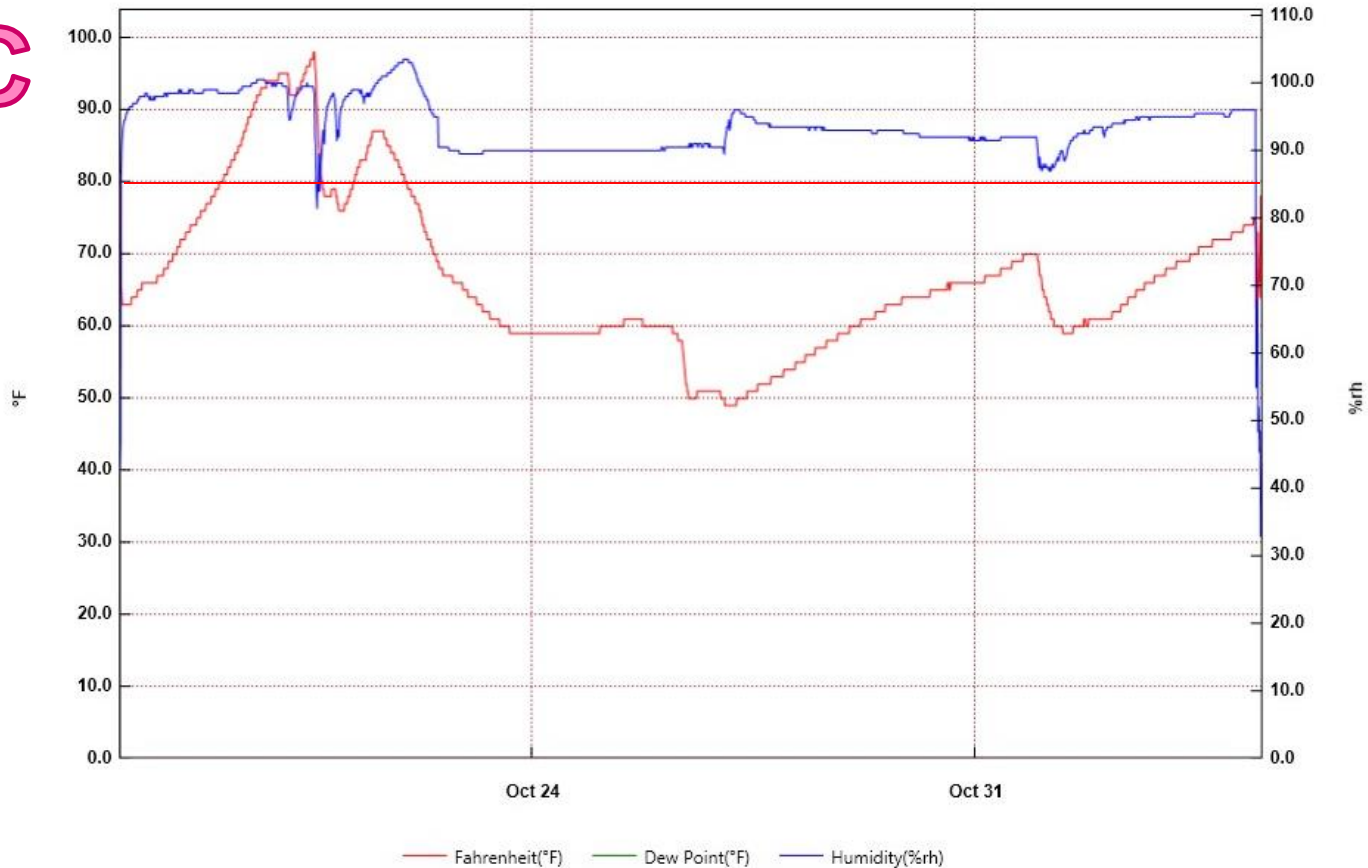
Fahrenheit(°F) Dew Point(°F) Humidity(%rh)

From: Monday, October 17, 2016 1:50:11 PM - To: Sunday, November 06, 2016 12:35:11 PM



Day "0" – Dry: Scald damage

36 C



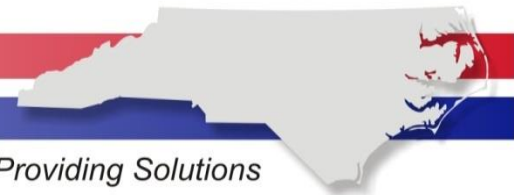
From: Monday, October 17, 2016 11:39:40 AM - To: Friday, November 04, 2016 1:09:40 PM



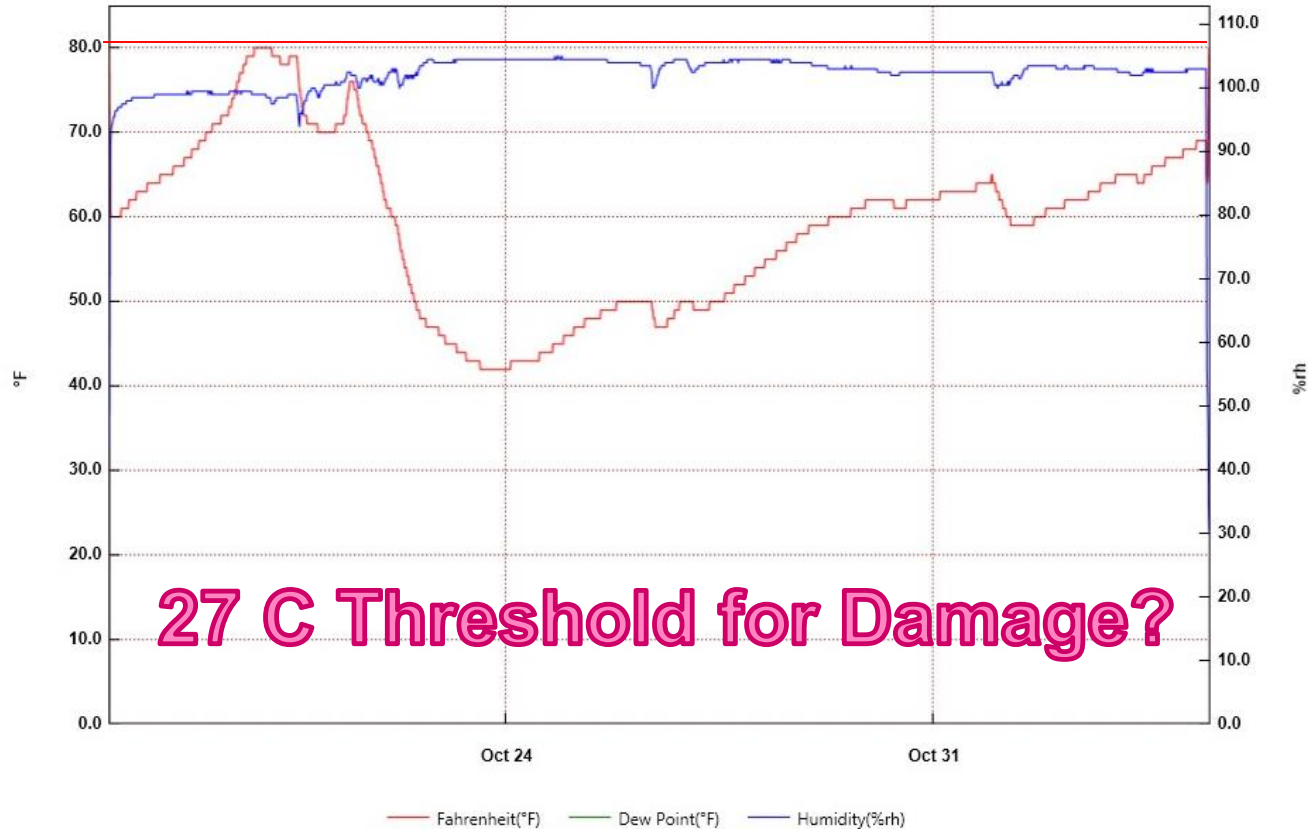
2016 Scald Damage



- Hot spot in upper third of pallet
- In line with 2x4 standards & thickest part of baled trees
- Very light damage was coin - sized



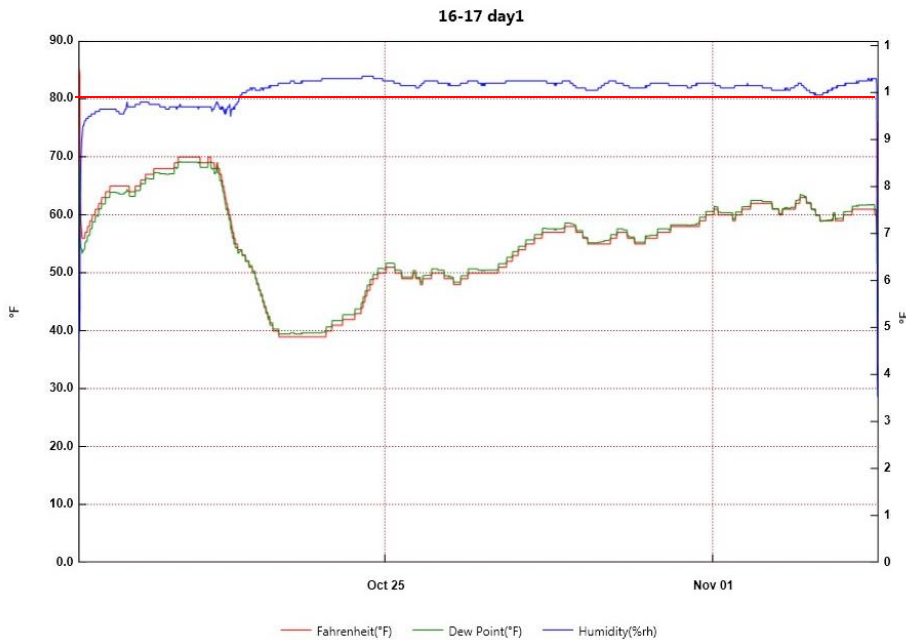
Day "0" – Wet: Minimal scalding



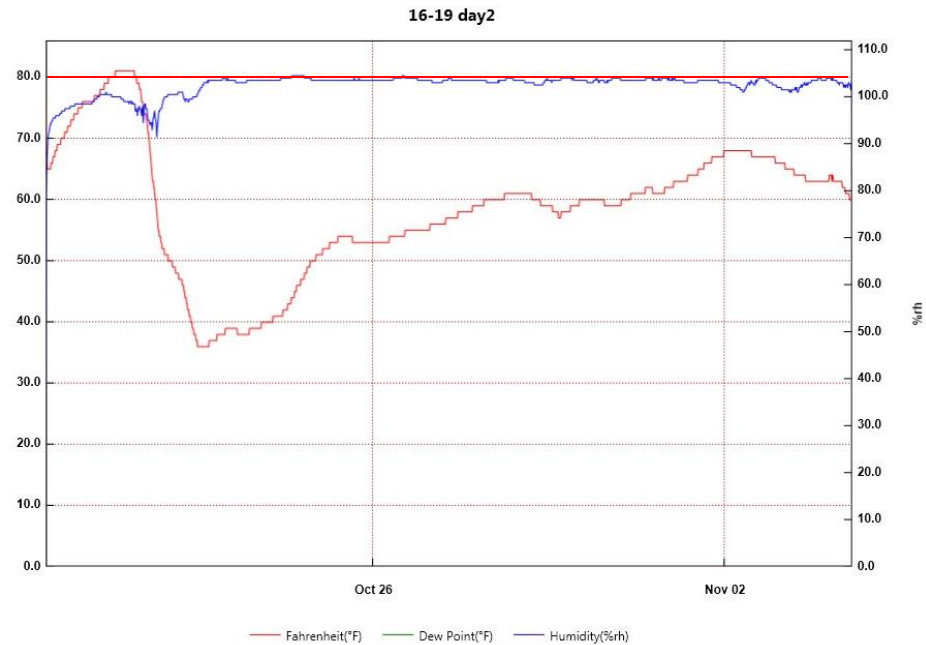
From: Monday, October 17, 2016 12:04:34 PM - To: Friday, November 04, 2016 1:04:34 PM



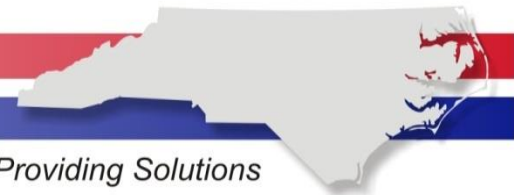
Days "1" & "2": Minimal scalding



From: Tuesday, October 18, 2016 10:51:13 AM - To: Friday, November 04, 2016 1:06:13 PM

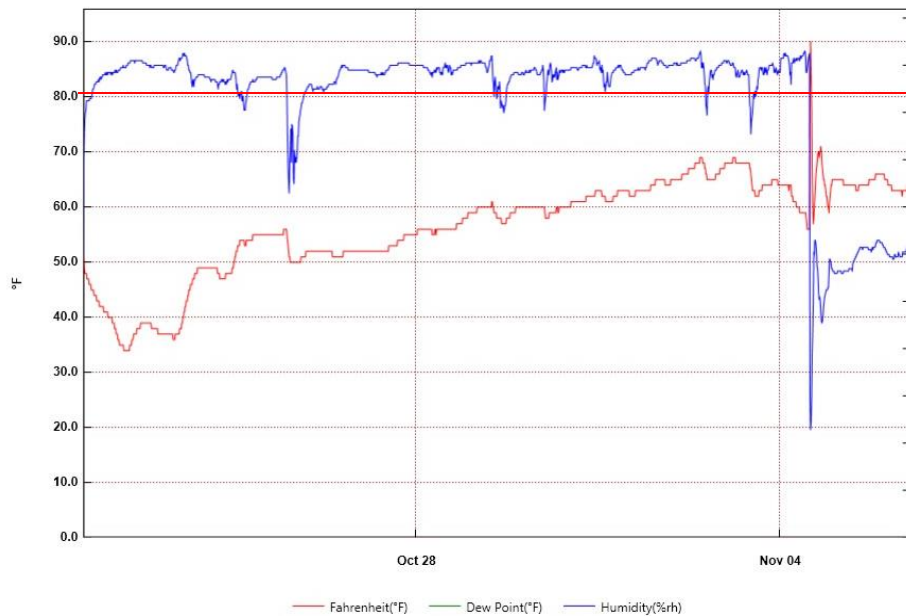


From: Wednesday, October 19, 2016 11:52:43 AM - To: Friday, November 04, 2016 1:07:43 PM



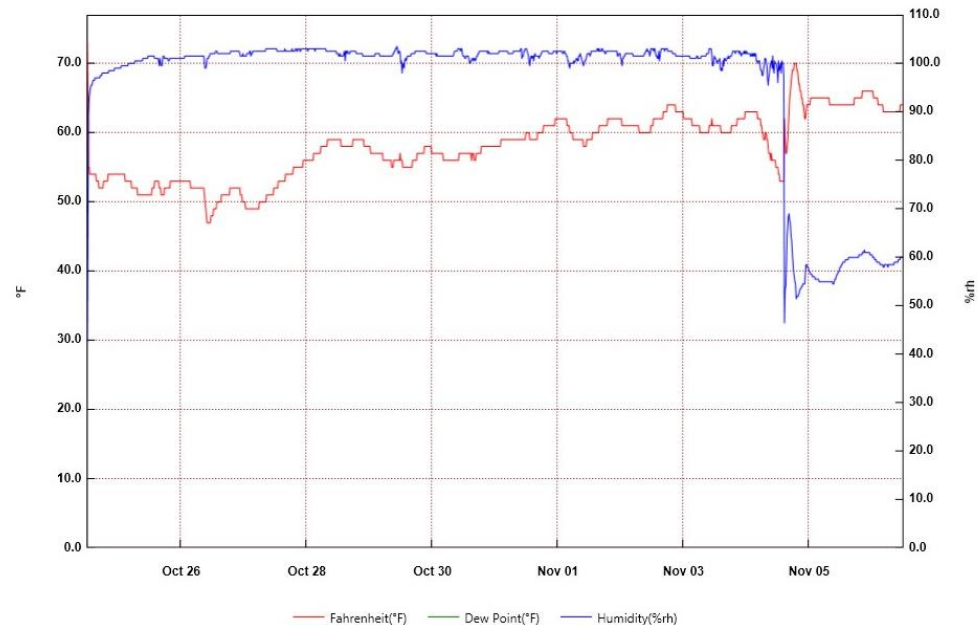
Days "4" & "7": No initial heating

16-21 day4



From: Friday, October 21, 2016 2:36:43 PM - To: Sunday, November 06, 2016 12:51:43 PM

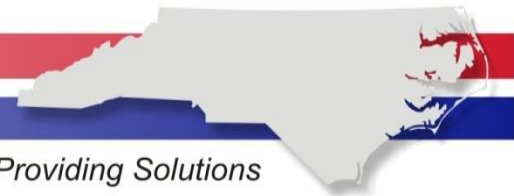
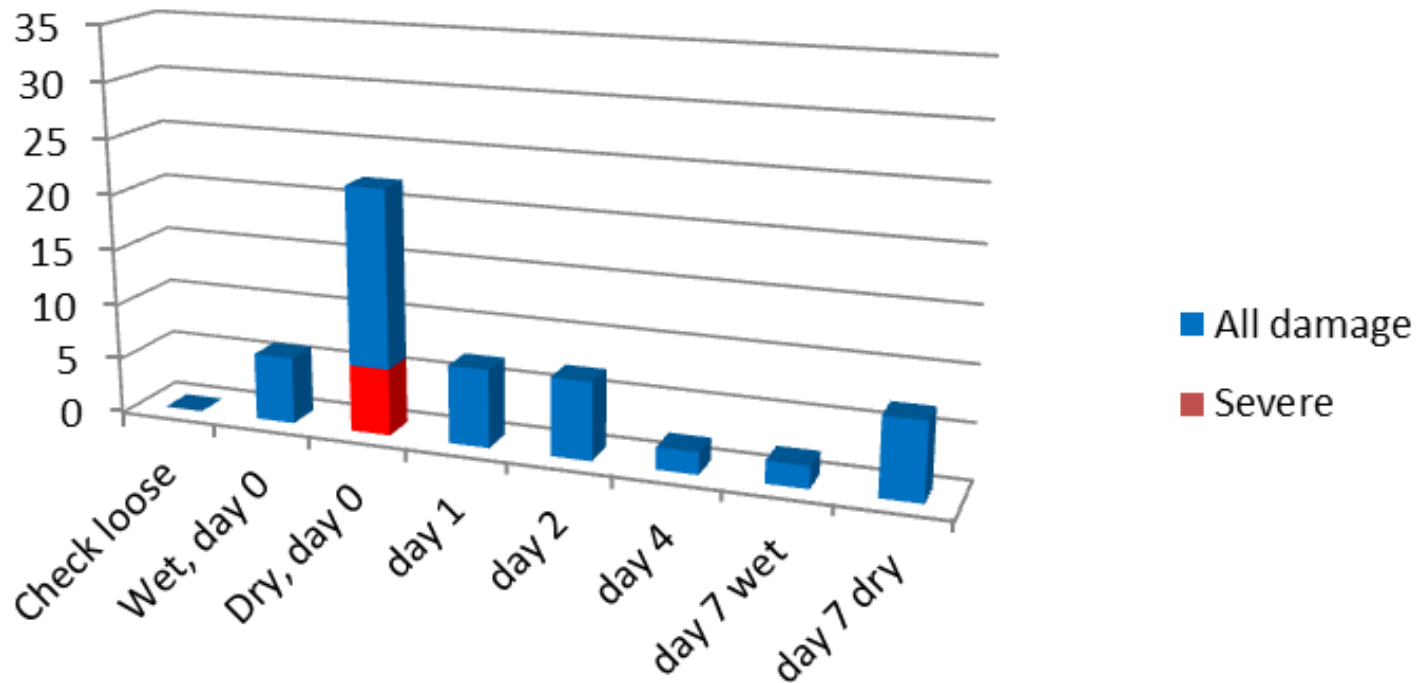
16-25 wet7



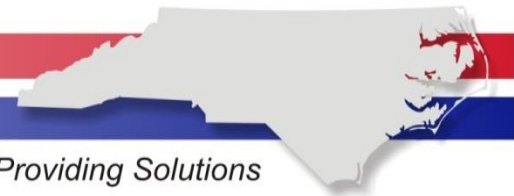
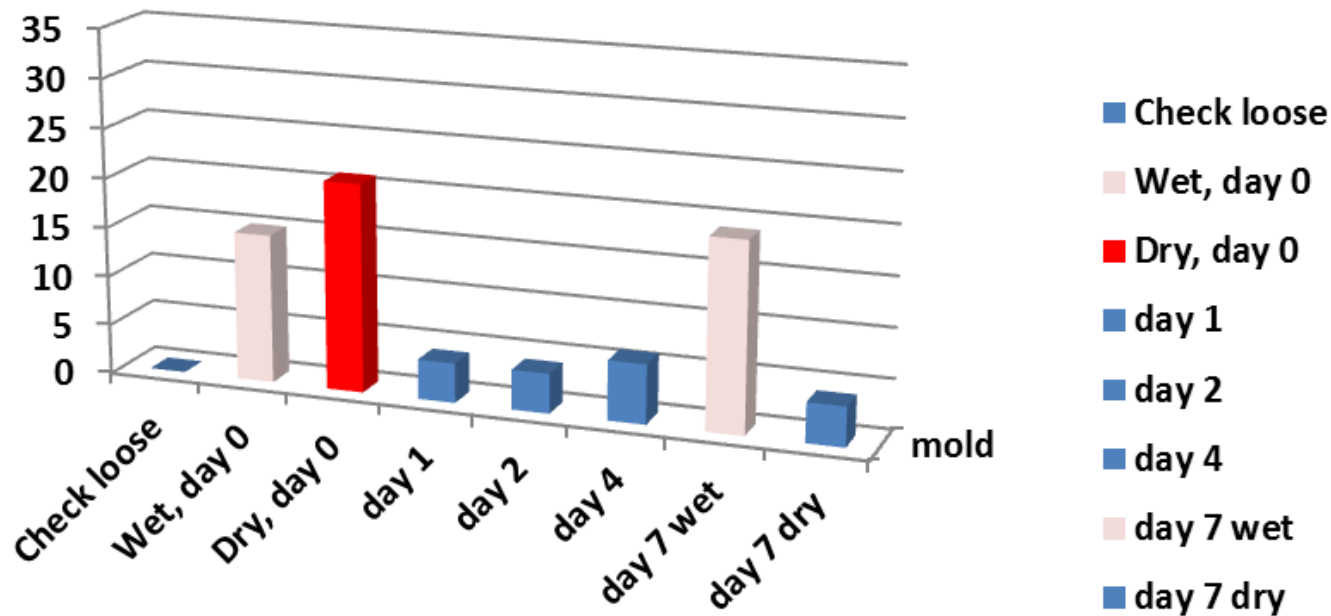
From: Monday, October 24, 2016 12:11:36 PM - To: Sunday, November 06, 2016 12:26:36 PM



Trees with any Scalding Symptoms



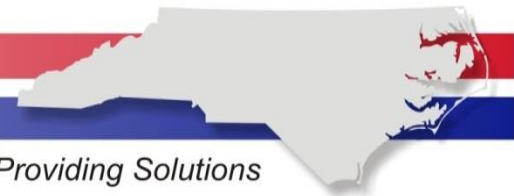
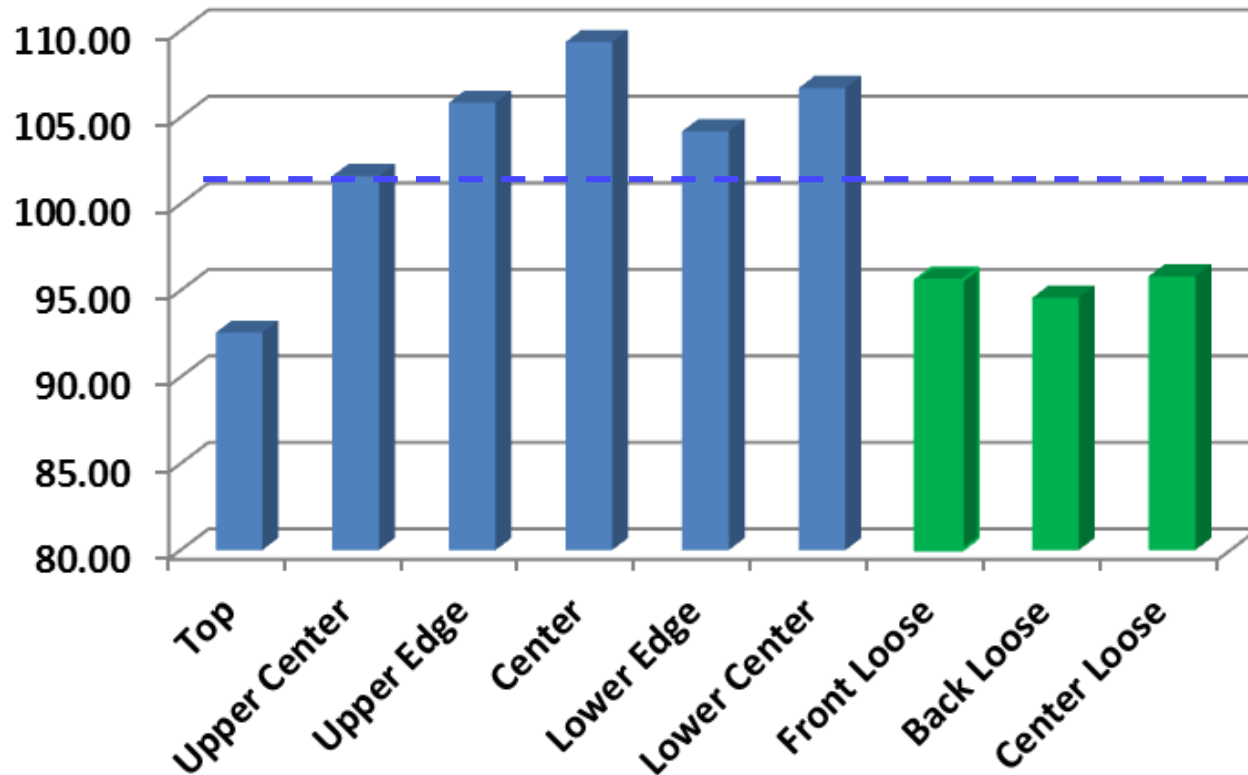
Trees with “Moldy” (?) Spots



MC% by Tree Position



MC % by Tree Position



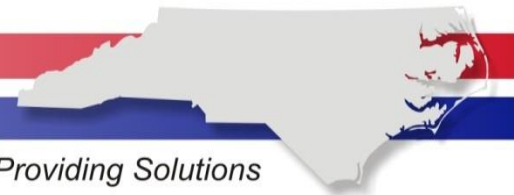
2016 Heat of Respiration

- Smaller issue with drought-stressed trees
 - BUT, heat was still captured in some pallets
 - “Bump” observed for days 0, 1, & 2
 - Day 4 MC% was influenced by cold snap
 - Tree position MC% revealed pallet weak points
- Pallets are moisture-conservative
 - A plus in dry conditions
 - A negative in wet conditions



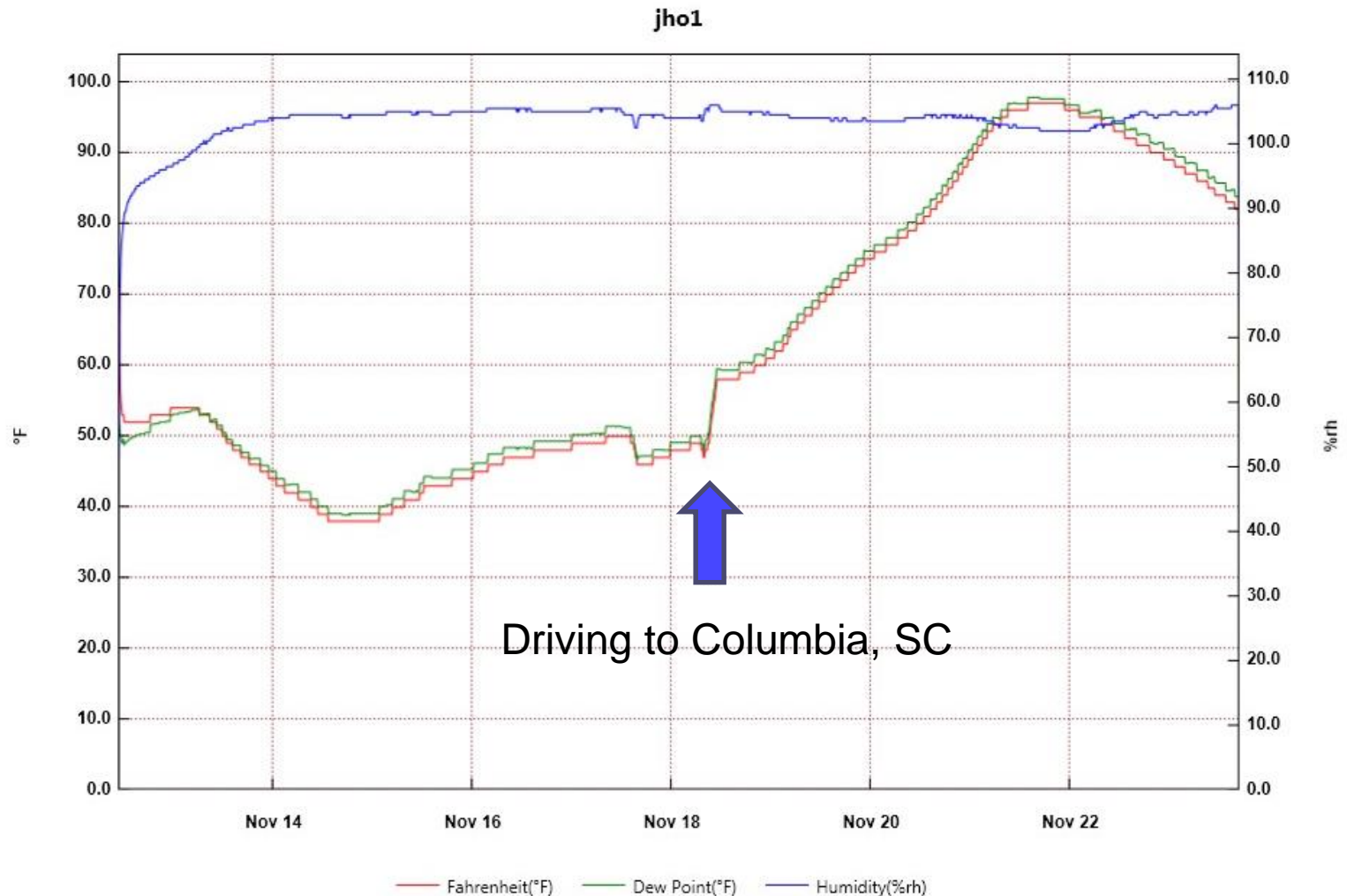
2015 Retail Pallet Study

- Trees were harvested on Nov. 4
- Trees were palletized on Nov. 12
- Took trees to Columbia, SC on Nov. 18
- 4 pallets opened on different dates:
 - Arrival, day 5, day 14, day 22
(Nov. 18, Nov. 23, Dec. 2, & Dec. 10)
- 140 trees also donated by Sexton Farms



2015 Retail Pallet Study

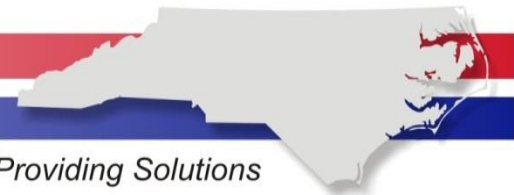
Nov. 23 Data Logger Data



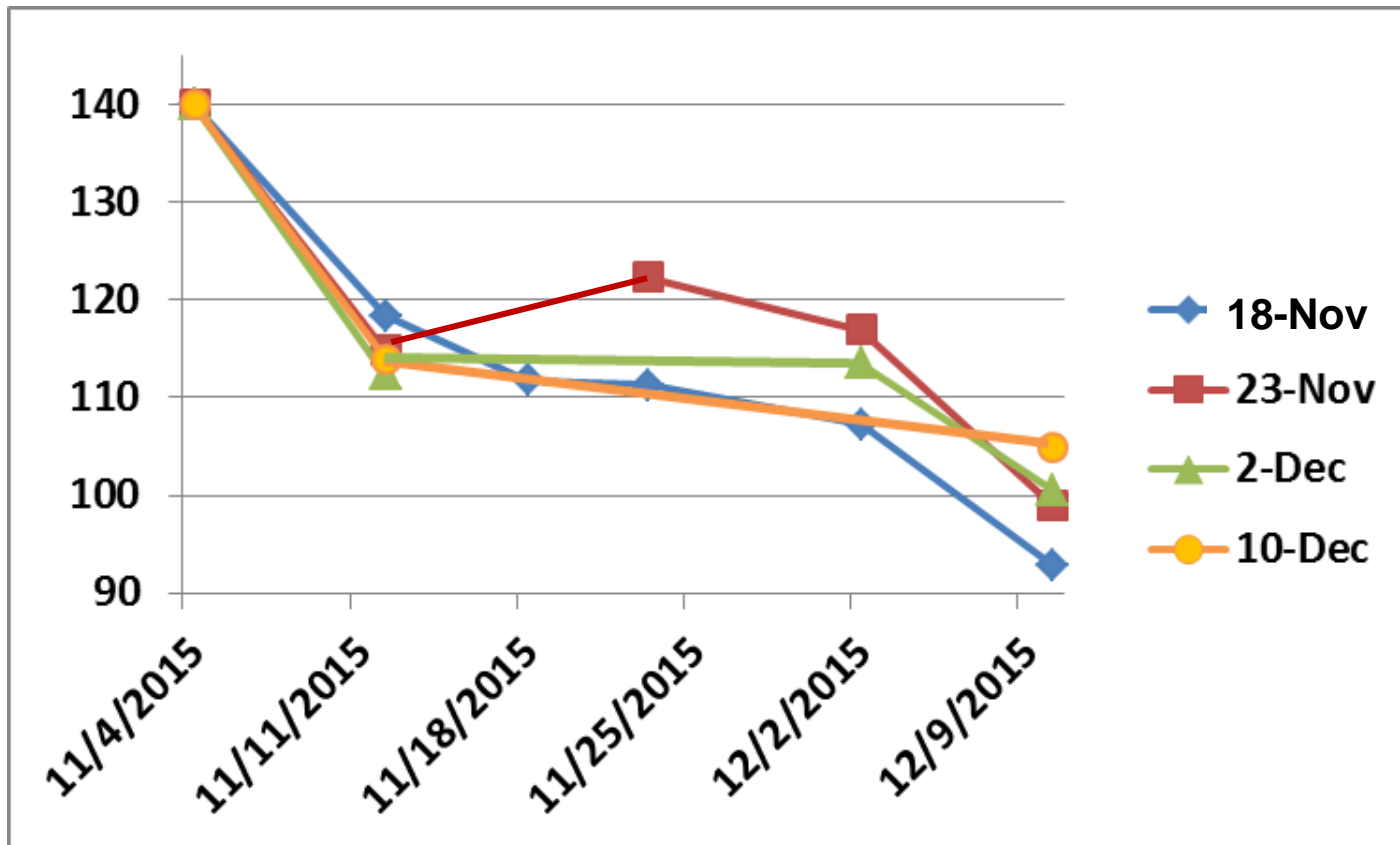
From: Thursday, November 12, 2015 10:46:39 AM - To: Monday, November 23, 2015 5:00:00 PM

General Observations

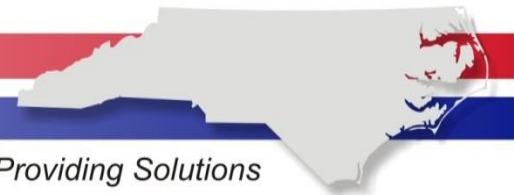
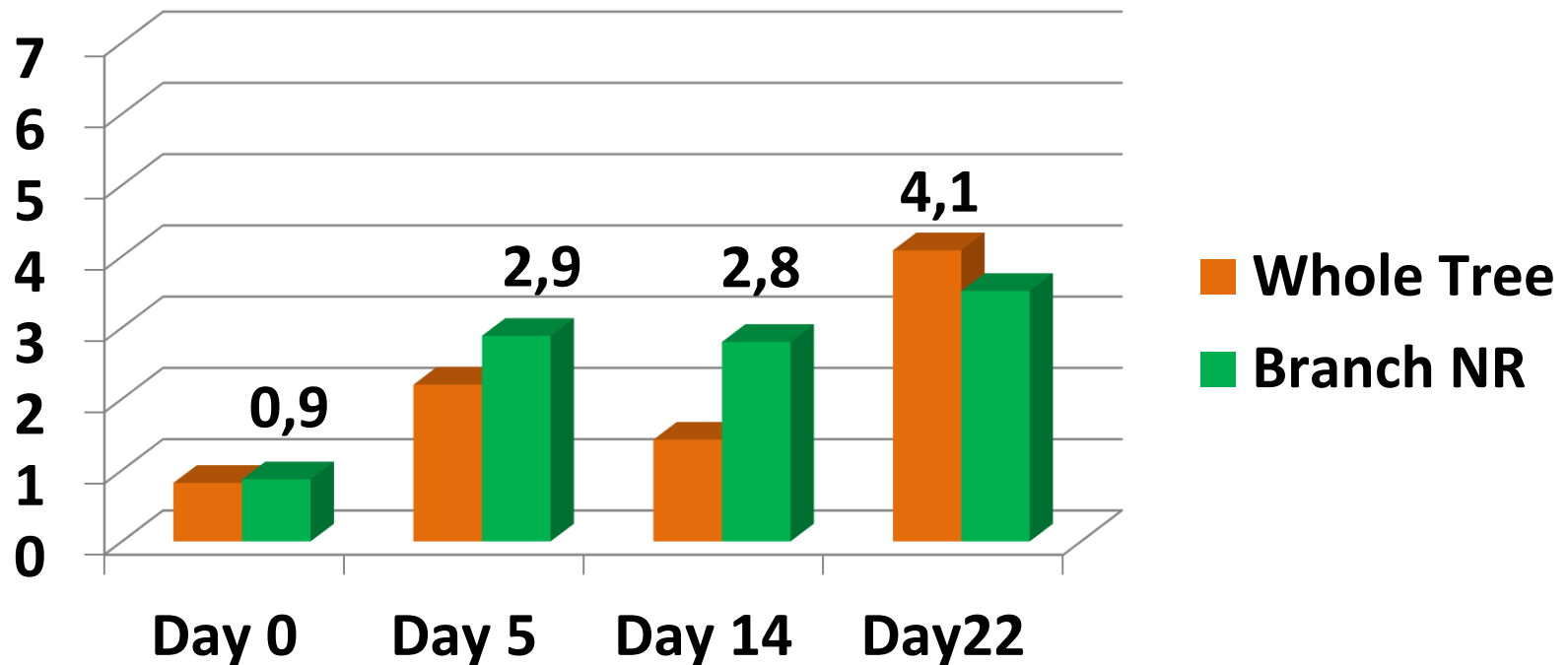
- Light damage was superficial, but moderate & severe damage went through baled foliage
- Did not find any “heat of respiration” bronzing
- Mold symptoms:
 - Dull brown needles
 - Localized needle loss
- Heat symptoms:
 - Bright green foliage
 - Waxy, slimy foliage



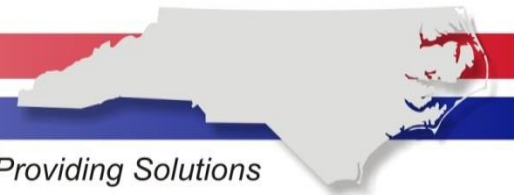
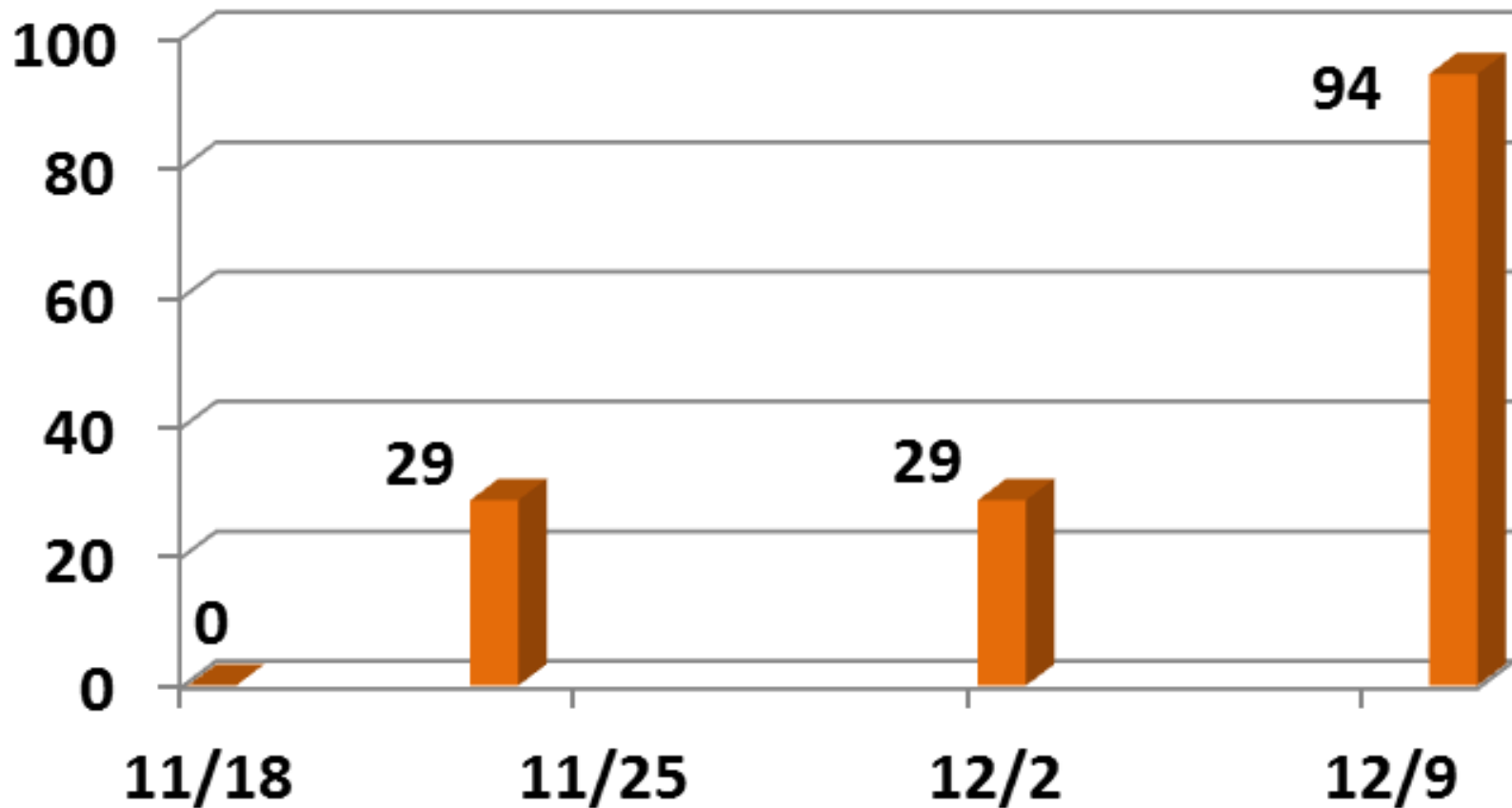
Percent Moisture Content



Average Needle Retention Rating on the Day Pallets Were Opened

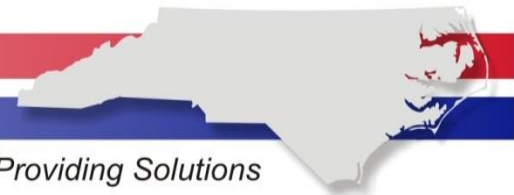
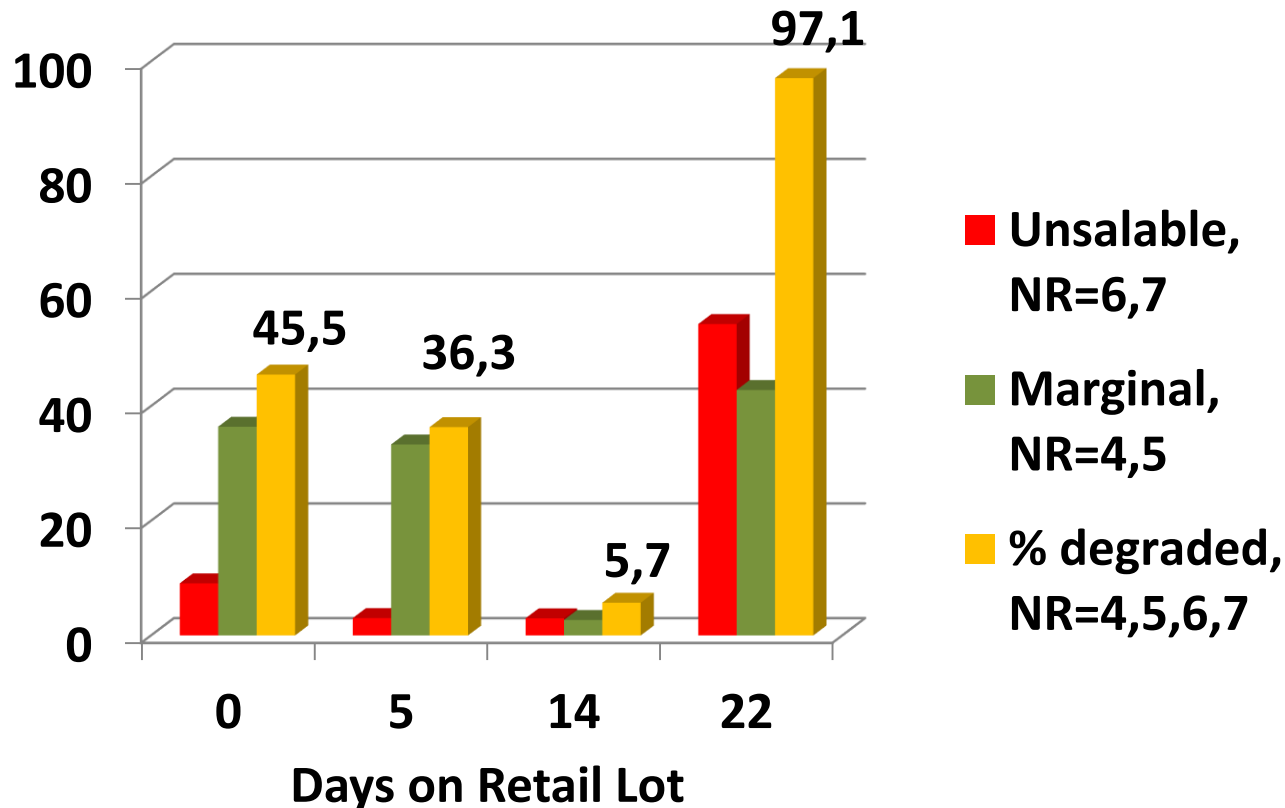


Percent of Trees with Visible Mold



Final Needle Loss Rating – Dec. 10

% Unsalable, Marginal, & Degraded

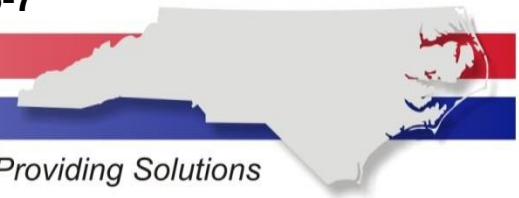
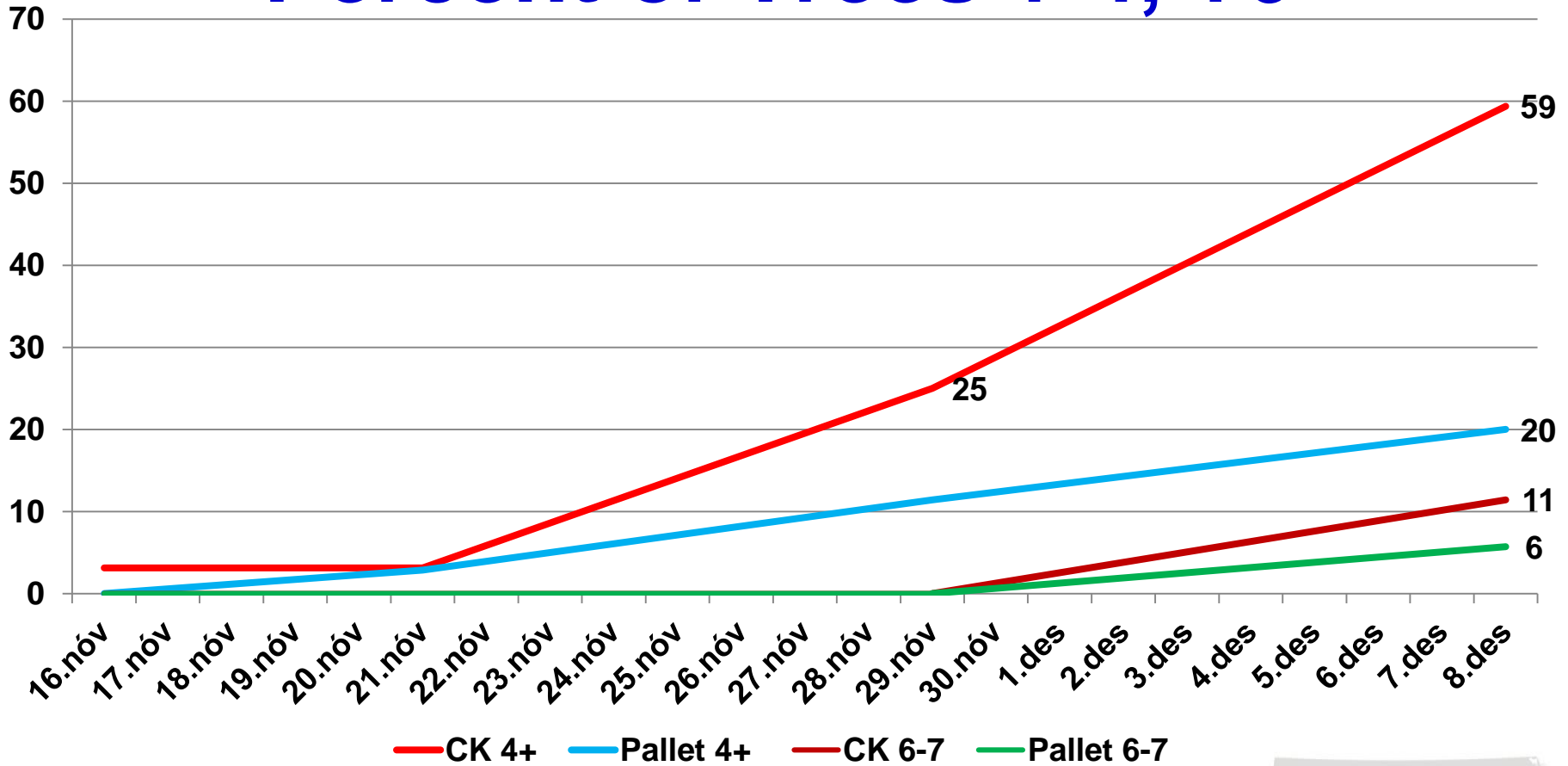


2016 Retail Pallet Study

- 4 pallets & a loose tree control (175 trees)
- Cut November 1 & palletized November 7
- Delivered to Columbia, SC on Nov.16
- Pallets opened:
 - Nov. 16
 - Nov. 22
 - Nov. 29
 - Dec. 8

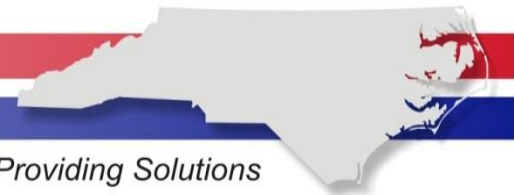


Retail Pallet Needle Retention: Percent of Trees + 4, +6



Retail Pallet Study

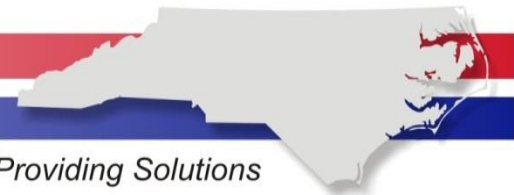
- In 2016, pallets of trees held up better than loose trees
 - Moisture content
 - Needle retention
- Very different from 2015 where trees degraded in pallets
- Leaves us with the question: Should we alter recommendations for different seasonal rainfall?



Forced Air Cooling of Pallets



- A possible treatment for heat of respiration
- Concept: To use portable fan(s) to pull “field heat” from trees during first night on yard
- Technology borrowed from fruit & vegetable postharvest research

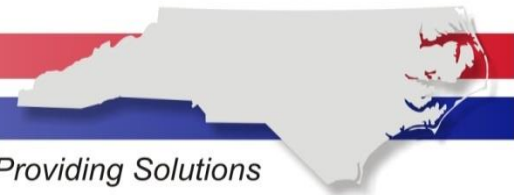


Forced Air Cooling Study

- Three variables:
 - Forced air (FA)
No forced air (check)
 - High density (35 trees)
Low density (30 trees)
 - 2 corrugated pipes
No pipes

Seven pallets

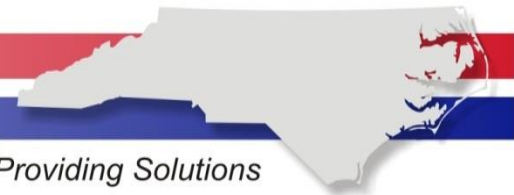
- FA – H – NP
- FA – L – NP
- FA – H – P
- FA – L – P
- Ck – H – NP
- Ck – L – NP
- Ck – H – P



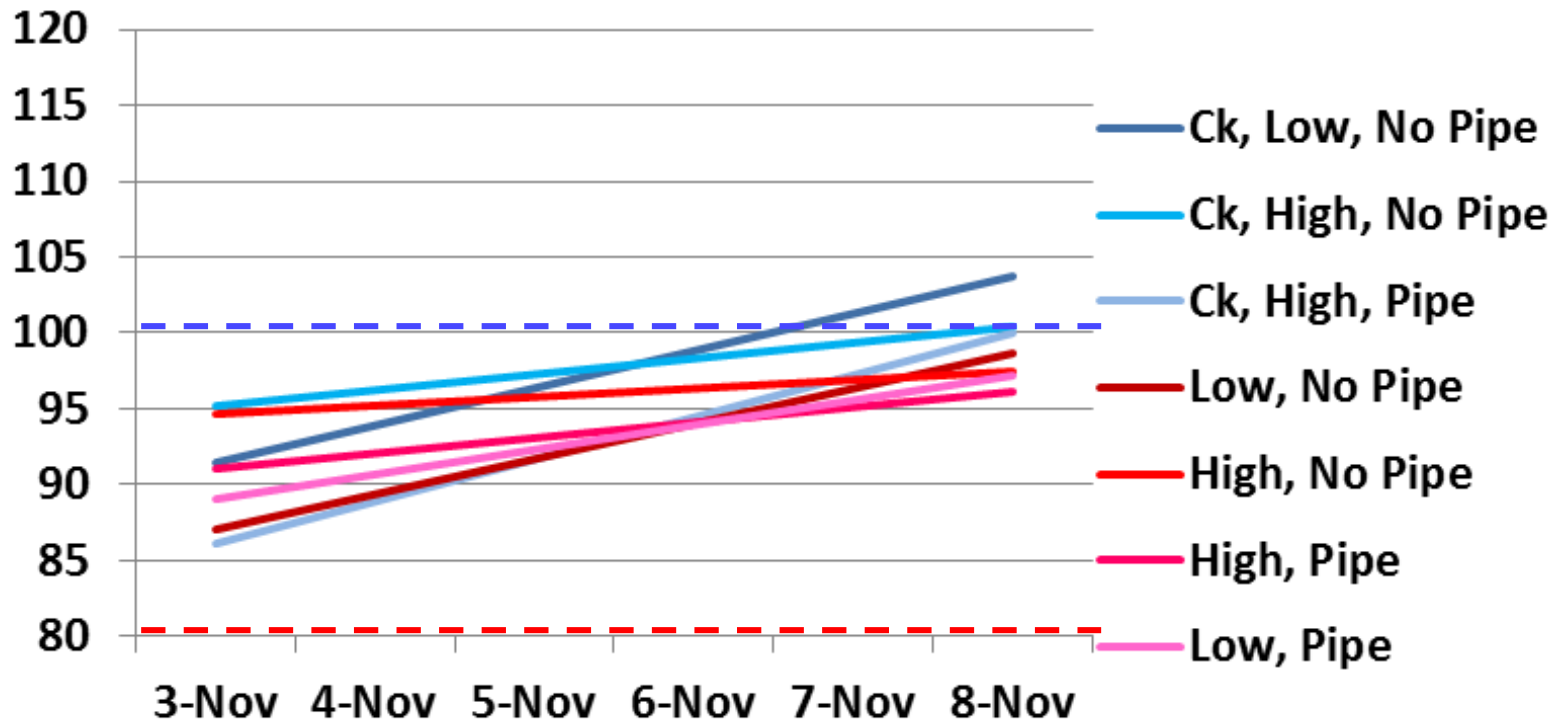
Carolina Fraser Fir

1 week duration

- Followed temperature more than freshness
- Observed uniformly acceptable needle retention
 - 1 & 2 ratings: near perfect to “very light” drop
- No sun scald or string burn
- No visible mold
- No degradation in any treatments
- All trees were released for shipment

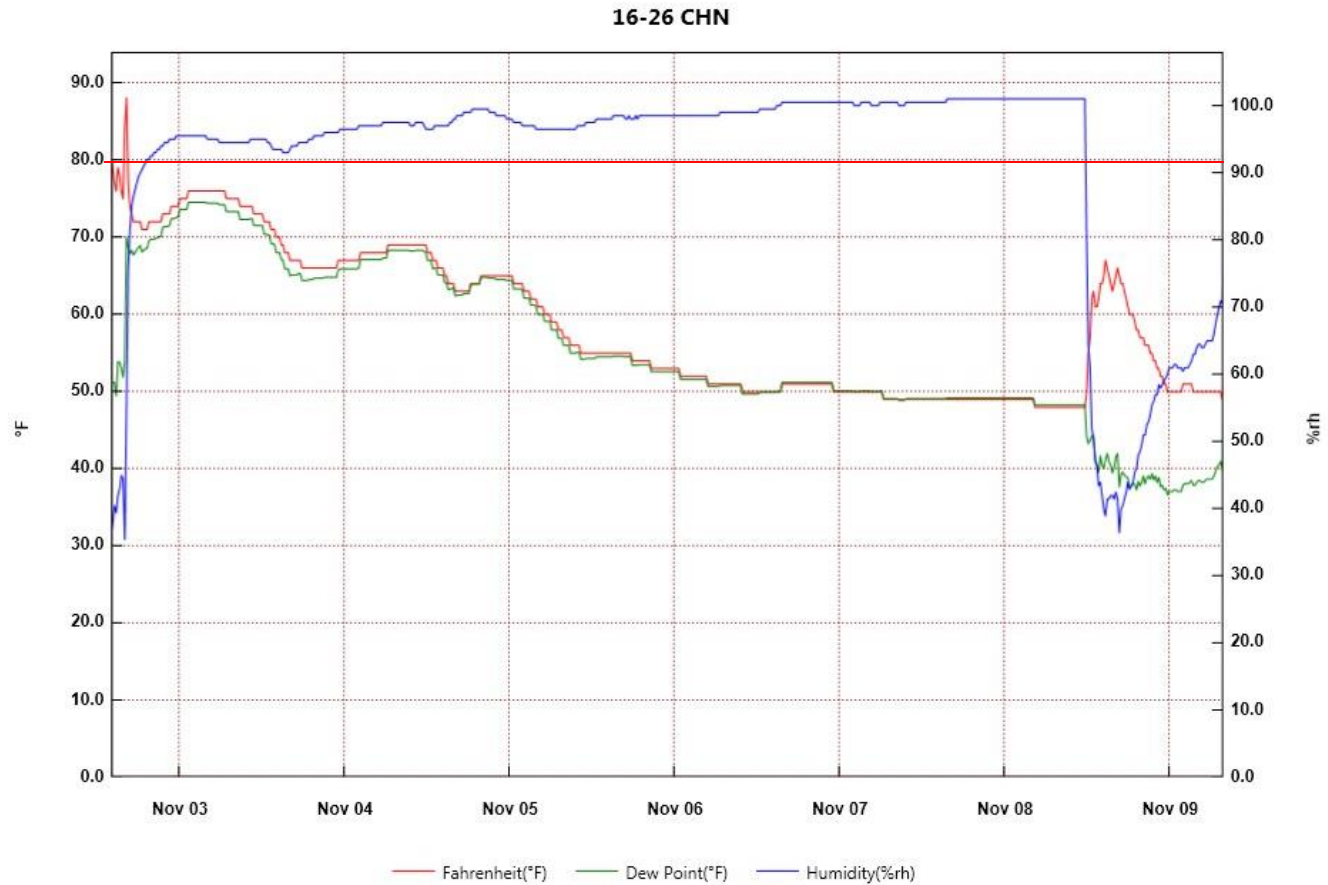


Percent Moisture Content



Check Temperature & Humidity

25 C

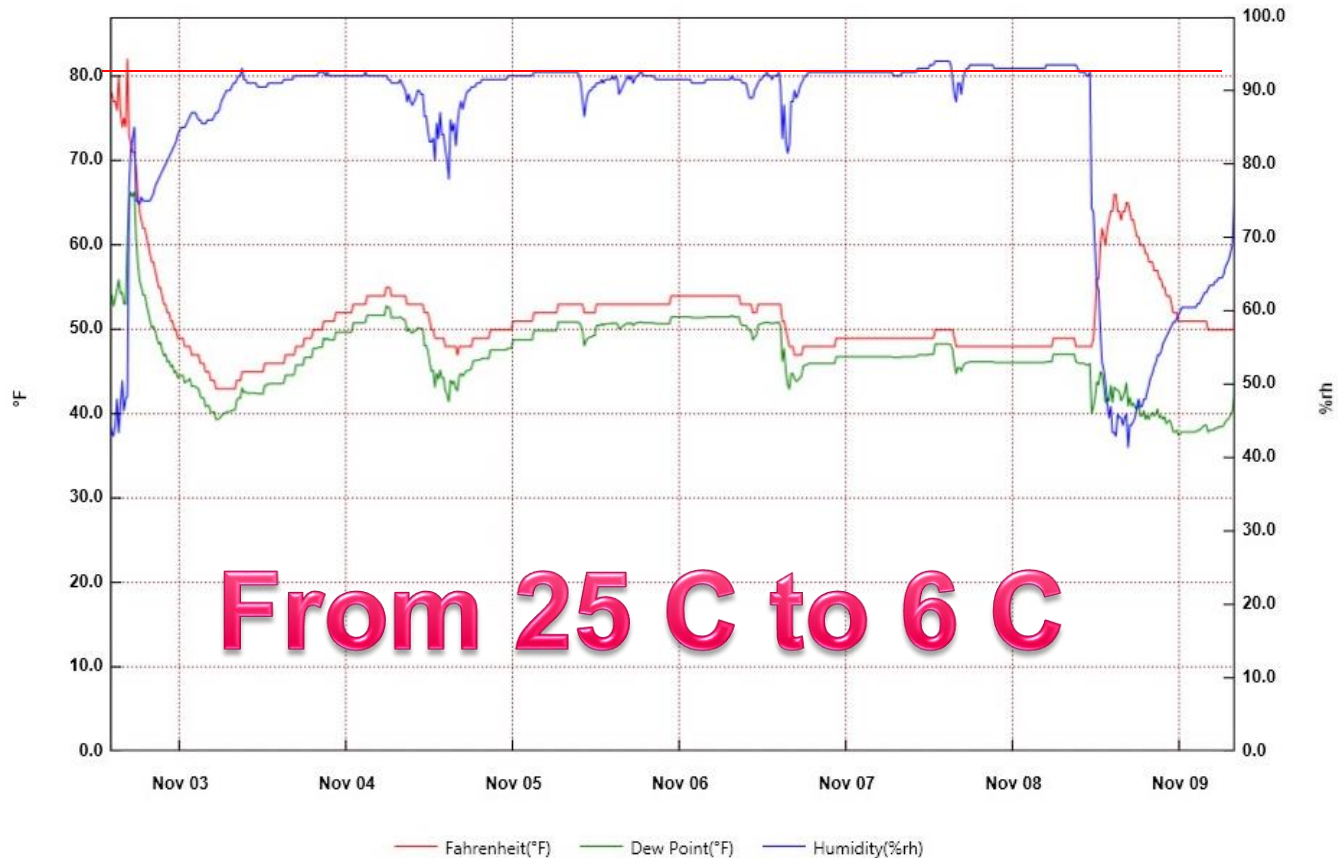


From: Wednesday, November 02, 2016 2:08:23 PM - To: Wednesday, November 09, 2016 7:53:23 AM



Forced Air Cooling – High Density

16-2 HN



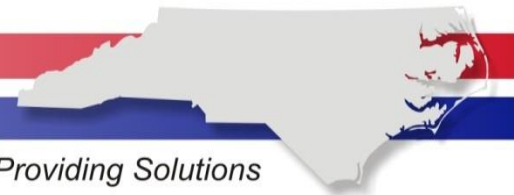
From 25 C to 6 C

From: Wednesday, November 02, 2016 2:03:05 PM - To: Wednesday, November 09, 2016 8:03:05 AM



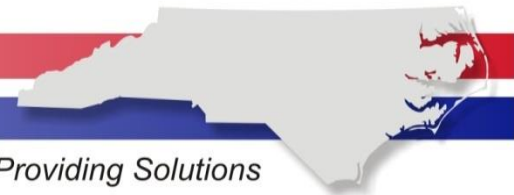
Forced Air Cooling

- It can pull “field heat” from trees
- It can reduce the magnitude of heat of respiration
- One night of forced air may not eliminate all heat of respiration
- Forced air may not overcome delayed microbial activity in wet or overly compressed pallets



Alternatives to Forced Air?

- 1-2 degree C reductions were observed with lower tree density & use of pipes
 - But it could be enough
- Data loggers recorded faster swings to ambient temperature & humidity with lower density or pipes

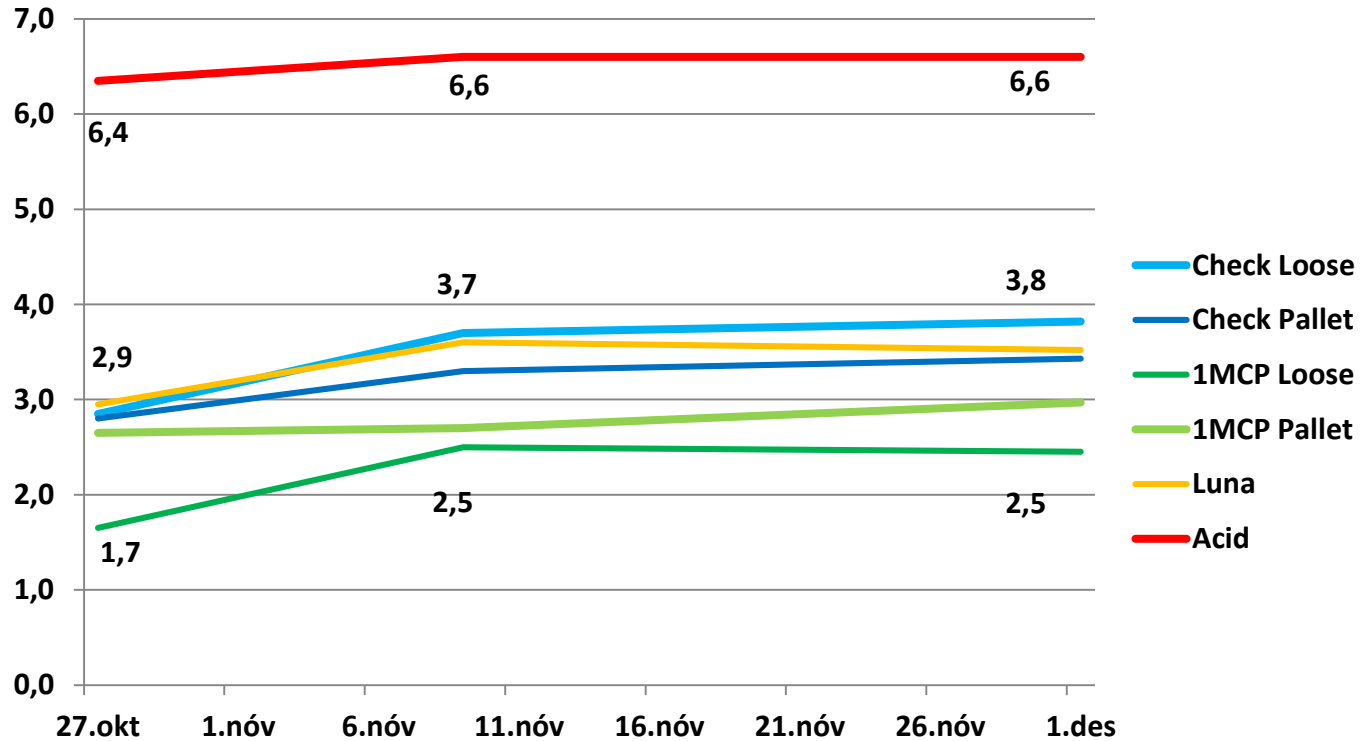


Amendment Study

- “Smartfresh” storage treatment for apples
- Treatments:
 - Loose tree check
 - Pallet tree check
 - Loose 1MCP gas
 - Pallet 1MCP gas
 - Included Bayer Luna fungicide
 - Propionic acid hay treatment

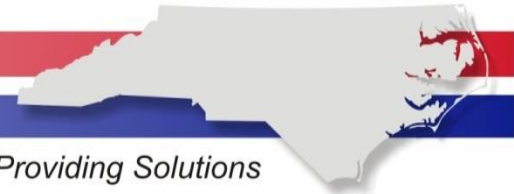


Needle Retention



1MCP Gas Treatment

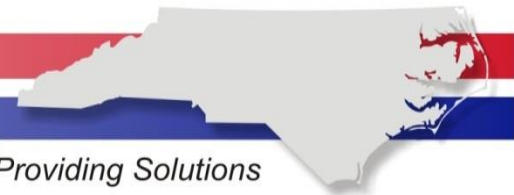
- Could be the difference between OK and really good needle retention?
- Better air circulation around loose trees
- Potential export applications?
- There is a spray formulation now



A Team Effort



- NCCTA grant & NCDA Specialty Crops Block Grant
- Growers provided trees & labor
 - G & S Trees
 - Kathy Shore Nursery
 - Sexton Farms
 - Carolina Fraser Fir
- Extension agents helped to plan & conduct the research
 - Jerry Moody
 - Travis Birdsell
 - Brad Edwards
- Upper Mt. Research Station



Questions?

